THE INTERNATIONAL SUGAR JOURNAL

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((*P*) implies *Paragraph.*)

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THE

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NOTES AND COMMENTS.

The West Indian Agricultural Conference, 1907.

Last month saw the somewhat tardy appearance in print of the technical papers read at the West Indian Agricultural Conference at Kingston last January. It will be remembered that the unexpected occurrence of an earthquake put a stop to the official programme, and a large number of the papers had to be read on board the steamer which conveyed the delegates back to Barbados. Very few details of their nature seem to have been obtained by the press at the time, and we have had to wait almost a year before the complete report has been published by the Imperial Agricultural Department for the West Indies in the *West Indian Bulletin*.

The papers relating to the sugar industry include several of more than passing interest. By far the largest space, however, is taken up by two papers on sugar cane experiments in the Leeward Islands and Barbados respectively, the ground of which has already been covered by the voluminous reports annually issued by the Experiment Station staffs of these islands. Of more interest is the paper on "Breeding Hybrid Sugar Canes," by Mr. F. A. Stockdale, the Imperial Mycologist, which we are reproducing in full in the pages

of this number and the next. Artificial cross-fertilization between selected seedlings has been known in theory at least for some time, but it is only of late years that experiments have been carried out on a practical basis to prove its value as a means of evolving improved species of canes at a more rapid rate than the ordinary methods of seedling selection offer. This cross-fertilization consists, as many of our readers will know, in fertilizing the flower of one variety of cane with the pollen of another known variety. Much of Mr. Stockdale's paper is taken up with a consideration of the hereditary characteristics possessed by the varieties which result from the crossing. The law of variability, as evolved by Mendel when experimenting on peas, first gave an explanation of those hereditary processes and Mr. Stockdale quotes at length examples of Mendel's work to help to illustrate them. It is the intention of the Experiment Station staff at Barbados to cross seedlings of approved reputation, and it will be interesting to learn the result. Perhaps at the annual Conference to be held this month at Barbados some information will be forthcoming. For the present we have to be content with knowing that last year they had 166 plants growing from five hybrid canes of known parentage.

The Hon. H. H. Cousins read a paper on "The Rational Use of Manures for Sugar Cane in Jamaica." He favours sulphate of ammonia as a concentrated source of nitrogen, since nitrate of soda is more liable to be leached, and is not so convenient for mixing with other manures. Jamaican soils are generally rich in available phosphoric acid, and many of them possess a store of phosphates largely in excess of any possible requirements of a sugar crop. There are, however, three classes of soil each requiring a different form of phosphatic fertilizer. For all the stiff soils and those of medium texture deficient in carbonate of lime, Mr. Cousins pronounces basic slag the best form of phosphate. For the soils rich in carbonate of lime (0·5 per cent. and over) superphosphate should be used, while on the light alluvial soils deficient in carbonate of lime the best results have been obtained from a mixture of two parts of steamed bone flour and three parts of good superphosphate. Basic slag, it is to be observed, must not be mixed with sulphate of ammonia, and superphosphate is incompatible with nitrate of soda in a mixture.

The Hon. Francis Watts had some interesting information to impart on the subject of mechanical tillage, especially as regards steam ploughing. Two Antigua firms lately imported sets of steam ploughing appliances from an eminent English engineering firm, and it is believed that such a method of tillage will successfully solve many of the problems at present met with in the working of the sugar estates. But some important initial difficulties have presented

themselves, owing to the peculiar conditions existing in Antigua. The ploughs were not of a suitable design to cope with their work, and only four acres a day could be got out of them instead of the 12 acres claimed for them by their makers. For further particulars we must, however, refer our readers to the paper itself, which is re-produced on another page in so far as it deals with the steam ploughing experiments. We would only remark here that Mr. Watts is surely quite right in concluding that "much more rapid progress and probably some considerable business developments would appear to be possible if the makers of the appliances could see their way to send out a skilled representative who would spend his time in visiting the various West Indian colonies, and observing the machines in operation." We do not know whether, since this paper was written, the firm in question have taken the hint. We believe that one of the most prominent firms of sugar machinery manufacturers in this country owes its success in no small measure to the fact that one of its partners has frequently travelled all over the sugar world and made himself pretty well acquainted with the requirements of different countries and climes. But we fear it is too often the case that a general engineering firm, by reason of the multifarious nature of the industries it caters for, is apt to be content with a less thorough exploitation of the needs of a particular industry than is the firm which specializes for that industry. As, however, a good deal of the economic success of sugar cane agriculture in the near future will depend on the successful solution of this mechanical method of tillage, we hope the problem of its elucidation will secure the full attention of Messrs. Fowler, and that the initial difficulties will be speedily overcome.

Estate Proprietorship.

In this number there are two separate articles dealing respectively with Queensland and Hawaiian sugar estate practice, wherein stress is laid on the importance of local proprietorship of cane sugar estates. It has been said of the West Indian estates that their chequered career can be partly traced to the prevalence of absentee proprietorship. There is a certain amount of truth in this, for it is evident that a Board of Control, existing say in London, cannot, other things being equal, exercise the same amount of supervision or give the same attention to details as can a proprietor or board of proprietors living within hail of the estate. If they do succeed in making a success of the venture, they do so *in spite of* their distant supervision, and not on account of it. And we think it is becoming clearly evident that the most successful undertakings are those wherein the whole body of cane-growers supplying a central factory have an interest in the concern and share the profits accruing therefrom. This has certainly been realized in Queensland, and steps have been

taken with every prospect of success to ensure an extension of this co-operative system. It was one of the serious defects of the Queensland Central Sugar Mill Companies as originally formed that they differentiated between cane-growers who were shareholders and cane-growers who were not. The former received extra facilities for producing their crops and a more favourable rate of pay for their cane delivered to the factory. Originally conceived, no doubt, as a practicable commercial policy, it proved a suicidal one in the long run. For as the number of new cane-growers increased, the favoured section became a hopeless minority. The new-comers however lacked the necessary incentive to steady and painstaking work, and in the end their contributions to the factory were so uncertain and irregular that the latter got heavily into debt, and was seized by the Government Controller. This official soon realized that the only chance the factories had of re-establishing their credit and regaining their original prosperity was to ensure that all cane should be paid for at the same rate, that every cane-grower who supplied the factory should *ipso facto* be a shareholder, that he should have a share of the profits proportionate with his share of cane delivered, and that none other persons should be eligible as shareholders. This system of equal treatment was instituted at once on those Central Factory areas which had fallen into Government hands. The results have fully justified the measures adopted. Six out of the ten factories have since discharged their liabilities, and the old companies having been bought out, new companies embracing all the cane growers have been formed and are expected to carry on operations with profitable results.

An occasional correspondent in the Hawaiian Islands, who contributes a most interesting paper to this number of the *International Sugar Journal*, likewise points to the benefits accruing from the same principle of ownership in those great sugar growing colonies. There co-operation has become a fine art; and the splendid sugar experiment station run by the Hawaiian planters, which has attracted to its staff scientists of different nationalities, is famous all over the world. In the West Indies, the same idea is extending, especially in Antigua where the new central factory seems to be meeting with well merited success; all of which points to the truism, which is being more and more recognised, that success is best achieved where the units which go to build up a central business all have a proportionate share in the whole of the ultimate profits instead of being paid at a fixed rate.

The Late Mr. H. O. Havemeyer.

America has just lost the most eminent person in her sugar industry in the death on December 4th last of Mr. H. O. Havemeyer, President of the American Sugar Refining Company since its organization, and the controlling factor in all its operations. He has been described as

a man of sterling integrity, strong personality, pre-eminent judgment and administrative ability. He came into prominence in 1887 when, realizing the unprofitable nature of the excessive competition then existing amongst the United States refiners, he put an end to their ruinous rivalry by forming a combine which grouped practically all the refineries under one management. This amalgamation, while benefiting the refining trade to an immense extent, apparently resulted in no great disadvantage to the consumers. The late Mr. Havemeyer's grandfather was a native of Schaumberg-Lippe, Germany, who in 1802 went to New York, where, with his brother, he started sugar refining. One hogshead of sugar was considered by them a good day's output. In 1823, the Havemeyers were the largest refiners in the States, and they have continued to hold that position ever since.

Independent Laboratory Tests.

The New York sugar refiners and merchants have just taken steps to start a laboratory for undertaking the independent polarization of sugar, such as will command the respect and confidence of buyers and sellers. It is to be under the control of trustees, and Dr. H. W. Wiley has been asked to select the chemist and his assistant. The charge for polarizing sugar is to be $1·00 per sample. For the purpose of providing for the equipment and expenses of the Laboratory, the sum of $6,000 is being subscribed in such amounts as may be agreed and by such of the parties interested as see fit to do so. To each subscriber 6 per cent. interest is to be paid yearly on the amount he may subscribe, also 5 per cent. to cover depreciation of plant. What surplus remains, after paying all expenses, is to be divided yearly among those who have had sugar samples tested, in proportion to the number of tests they have had made. This is a step in the right direction. It is always advisable in commercial transactions to have at one's command a cheap and expeditious means of settling any disputes which may arise between buyer and seller. In the United Kingdom this principle has been so well realized that the Chambers of Commerce in several towns have gone to the expense of fitting up Testing Houses under their control for the testing of samples submitted by local traders; and the support given to these has been sufficiently ample to pay expenses and leave a profit. This profit, however, is not divided among the interested parties, but is retained by the Chamber to meet their general expenses.

The Hawaiian Islands Crop.

The sugar crop of the Hawaiian Islands for the year ending September 30th, 1907, reached a total of 440,017 tons, slightly exceeding the previous record crop of 437,991 tons in 1904. Of this amount 143,891 tons were produced in Hawaii, 104,772 tons in Maui, 119,273 tons in Oahu, and 72,081 tons in Kaui. The acreage

harvested was 99,716 acres, the average return per acre being 8,826 lbs.; the acreage under irrigation gave an average return of 11,525 lbs. per acre, that under natural rainfall producing at the rate of 6,054 lbs. per acre. The largest amount of sugar produced in any one factory was 44,143 tons; besides this, one factory turned out over 30,000 tons, five factories made each between 20,000 and 30,000 tons, six between 10,000 and 20,000 tons, and eighteen between 5,000 and 10,000 tons. These factories produced between them approximately 90 per cent. of the total production of the islands, the balance of the crop being produced by fourteen smaller factories.

RUSSIA'S ADHERENCE TO THE SUGAR CONVENTION.

(*Reuter's Telegrams.*)

We went to press last month just a few days too early to be able to report the results of the Sugar Conference at Brussels. As will be generally known by now, Russia has agreed to become a party to the Convention. The nature of the conditions attached to the new agreement can best be gleamed from a perusal of the following Reuter's telegrams which appeared in most of the morning papers of December 5th and 21st last:—

"Brussels, December 4th.

"Russia is to maintain her present fiscal and customs legislation regarding sugars without being able to increase the advantages ultimately to be reaped by the producers from the maximum price of sale fixed for the home markets. On the other hand, the amount of sugar that Russia may export in competition with the sugars of the markets of the contracting parties from September 1st, 1907, until August 31st, 1913, may not exceed 1,000,000 tons. As by very reason of her internal legislation, Russia's exports cannot but be essentially variable from one year to the other, and as it is contrary to the interests of the contracting parties to authorize that country to carry over, unrestrictedly, from one year to another the export bounties which have not been used, the maximum quantity to be exported has been fixed for the various years. The amount is divided as follows:—

	Tons.
For the two years between September 1st, 1907, and August 31st, 1909	300,000
From September 1st, 1909,-August 31st, 1910..	200,000
From September 1st, 1910,-August 31st, 1911..	200,000
From September 1st, 1911,-August 31st, 1912.	200,000
From September 1st, 1912,-August 31st, 1913..	200,000
Total..	1,100,000

"It will be noticed that the grand total is 1,100,000 tons, a total which cannot be attained since the figure of 1,000,000 has been fixed as the highest possible figure for export. There has merely been a desire for a larger margin for the contingent each year, so that Russia may have an opportunity of withdrawing in some measure the export bounties not used previously."

"Brussels, December 20th.

"The Protocol of the International Sugar Conference which has just been signed states that Russia adheres to the Convention of March 5th, 1902, amended by the additional Act of August 28th, 1907, which fixes the conditions under which Switzerland was admitted to the Sugar Convention. It has been agreed that the mission entrusted to the Permanent Commission by Clause A applies to Russia likewise, in the sense that the Commission will have to see that Russia continues to conform with the obligations of Articles 1, 2, and 3 of the Protocol. Russia will have to take all necessary steps to prevent sugar exported to Finland from being sent elsewhere without being carried to the account of exports. The Russian Government will at the end of each year compare the total amount of sugar registered as exported to Finland with the amount of sugar actually imported into that country. The difference between the two figures shall be included under the heading of exports. It has also been agreed that the dates mentioned in the Protocol are those of the Gregorian and not of the Julian Calendar.

"The question of the protection of the markets of Germany, Austria-Hungary, and Sweden—countries which form part of the international union against the importation of Russian sugar for internal consumption—will be settled directly by the countries concerned through diplomatic channels. The Protocol is signed by the delegates of the various Governments.

"The British delegates made the following reservation:—'The assent of the British Government to the previous Protocol is limited to the provision enabling Russia to adhere to the Convention, and does not imply assent to the stipulation tending to restrict the importation of Russian sugar.'"

These telegrams appear to us to be in some respects obscure, even unintelligible, and probably in parts erroneous. We give elsewhere what we believe to be the essential points of the agreement.

It is reported that the sugar planters of Cuba have formed themselves into an Agrarian League to press the economic conditions of the island on the attention of the Provisional Government. The establishment of agrarian banks and more free trade with the United States are among their chief demands.

THE FATE OF THE NEW SUGAR CONVENTION.

II.

The first chapter under this heading had to be published at the critical moment when we were daily expecting the verdict from Brussels. We now have the full details of the decision arrived at by the Permanent Commission, and can consider from every point of view the actual situation.

That skilful and conciliatory diplomatist, M. Cappelle, President of the Permanent Commission, is to be heartily congratulated on the successful task he has accomplished in bringing so many conflicting interests into permanent agreement. Our delegate, Sir Henry Bergne, also deserves the thanks of all the industries represented at Brussels for the part he has so ably discharged in this difficult process. The same congratulations are due to the delegates of Germany, Austria, and France, and to the many representatives of the industries of those countries; and last, but not least, to the Russian delegates and industrial representatives, who came prepared to discuss the matter in a broad and liberal spirit, and who so thoroughly succeeded in bringing it to a satisfactory conclusion.

Our previous articles have sufficiently indicated the many difficulties in the way of an agreement. Let us take Russia in the first instance. The Government of that country found themselves in the happy position, owing to the extraordinary action of the British Government, of being able to send their sugar into this country after the 1st September, 1908, without let or hindrance. They have, nevertheless, consented to limit that freedom. They see that it is to their interest to do their part in endeavouring to maintain even a mutilated Convention which may still secure the sugar industries of the world against a revival of the sugar bounties. They have done their part well and we are grateful to them. Exportation is to them pure loss, they have no desire to produce too much sugar. It is an unfortunate result of their system which brings about that misfortune. Large sowings two years ago were followed by an exceptionally good yield. The excess so produced was not sufficiently manifest when last year's sowings were undertaken. Again they have had a good crop, and the total excess of production over consumption in the two years will amount to something like half a million tons of sugar. They are not likely to repeat this ruinous process. Their exports, outside Finland and Persia, must be made at a dead loss. Neither the Government nor the industry desire to lose money. We may, therefore, fairly assume that the present over-production will not be repeated.

As to France, Germany, and Austria, they have done well to accept the compromise with Russia rather than wreck the Convention. The Governments of those countries have no desire to revive the bounties. The industries of those countries have no wish to see the price of 88% beetroot sugar go back to the level of 1901-02. They have embarked on an entirely new journey in their industrial progress. They look for a time when the European continental consumption of sugar will be large enough to take the whole production of the vast and beneficent industry of beetroot sugar cultivation. Any opposition on their part to the agreement arrived at in Brussels would be a fatal blow at the prosperity of their own industry. Reduction of duty followed by increased consumption is their only salvation, and we firmly believe that that policy will be pursued in all those countries, and that in a few years we shall see an enormous increase in the continental consumption, coupled with a healthy and natural prosperity of the industry, no longer troubled and perplexed by the feverish excitement of competing bounties, violent fluctuations and fatal glut, followed by the inevitable collapse of markets and terrible ruin.

Russia has now become a party to the Sugar Convention and has assumed all its rights and duties, except that it retains its present fiscal system, which is not in any way to be modified in favour of its sugar producers. Its exports are not to exceed a million tons up to 31st August, 1913, in equal quantities of 200,000 tons per annum.

A decrease in one year is not to be made up by an increase in the following years.

These exports do not include the normal exports to Finland, Persia by land or by the Caspian Sea, Asia by land but not including Turkey in Asia. These normal exports amount to about 130,000 tons per annum.

Russia is to come to a separate agreement with Germany, Austria and Sweden by which exports of Russian sugar to those countries will be prohibited.

Russian sugar, of course, will not be admitted into the United Kingdom till 1st September, 1908.

The West India Committee are distributing free some copies of a pamphlet, entitled "Tobago: Hints to Settlers." This pamphlet calls attention to the favourable openings afforded by Tobago for young men possessing the necessary capital and energy to start cocoa, rubber, cotton and other forms of cultivation in this island. For bringing about 100 acres of forest land into full bearing in cocoa, from £2,000 to £3,000 is needed.

THE OUTLOOK FOR THE SUGAR INDUSTRY IN 1908.

An excellent review of "Sugar Refining in Greenock during the year 1907" appeared in the *Greenock Telegraph* a few days ago from the pen of a well-known authority in that district. We must defer till next month the task of presenting to our readers the gist of the information it contains; but we cannot refrain just now from quoting the writer's remarks on the outlook for the coming year, as, in his reference to the sugar duty and to Russia, he clearly hits the nail on the head.

"There are two disturbing elements which have to be reckoned with by our sugar refiners in the coming year. The one is a possible reduction or abolition of the sugar duty, and the other is the modification of the Brussels Convention. The advocates of the "Free Breakfast Table" managed at last Budget time to get an indication from the Chancellor of the Exchequer that the first rearrangement of indirect taxation would be the sweeping away of the tax on sugar. Mr. Asquith did not, indeed, commit himself to any definite date at which he expected to be able to dispense with this source of income; and it is almost inconceivable that, while he remains in the same mind as he was in last year as to the wisdom of bringing the National Debt as speedily as possible down to the figure at which it stood before the South African war, he can dispense with or curtail any source of revenue. Yet rightly or wrongly, some people connected with the sugar trade have taken it into their heads that next spring will see the end of the sugar tax. Consumers and retail grocers, whose stocks are not held "under bond," will, in order to secure themselves against any eventuality, restrict their stocks, and consequently, their purchases to the narrowest limits during the three or four months between now and the Budget; and our refiners, if they keep their works going, will find their production to a large extent unsaleable and their warehouses overcrowded. Year after year traders in commodities subject to duty have to suffer from a disturbance of trade brought about by the possibility of a change in the rate of the duty. It would be well if articles, such as sugar, which are the raw materials of complicated manufacturing processes in this country, were never selected as appropriate subjects for taxation. But should the consideration be allowed to prevail that such an article is, in consequence of its universal use, the best fitted for an impost which will fall upon everybody impartially, there should be some reasonable understanding arrived at that the rate of duty, once fixed, should not be subject to modifications for a period of at least ten years, so that the trade should be spared the annual uneasiness which at present afflicts dealings in taxable commodities.

"The other important cause of concern to our refiners that will come upon them in the course of 1908 will be the effect of the modification of the Brussels Convention, which will be brought about in consequence of the recent negotiations, whereby Russia may be allowed to come in to the number of Convention countries on terms distinctly better than those enjoyed by the original contracting parties. It is most unfortunate that just when, by the force of circumstances, Russia was on the point of being obliged to come into exact line with the other contracting Powers, in order to obtain a better outlet for her surplus production, the Government of Britain should have so completely played into the hands of Russia as to warrant the latter in holding out for exceptional treatment. It is not quite clear yet what the details of the proposed agreement amount to; but it appears that, in the circumstances, the best that the other Powers could obtain from Russia is a qualified adhesion to the Convention, coupled with a proviso that she is to be permitted to export about 200,000 tons of bounty-fed sugar per annum during the five years for which the Supplementary Act is to remain in force. The other Powers probably thought it better to prolong the Convention with this limit to the bounty-fed export of Russia, and with the continuance of Britain as a partial adherent to the Convention, rather than that Britain should withdraw altogether. It is a great disappointment to the trade in this country that His Majesty's Government did not, when the question of denunciation of the Convention was considered by them, judge it by its results; for, in that case, there would have been no ground for asking to be relieved from the necessity of enforcing the penal clause. Under the Convention no one of the bad results, imagined beforehand as inevitable, had been actually realised, and the benefits predicted had been steadily reaching fulfilment. To ignore these results and hark back upon opinions expressed in the heat of political controversy, which events have completely falsified, as the justification of a policy breaking the continuity of action which usually characterizes the policy of the British Government with regard to its relations with foreign Powers, is hardly what was to be expected from a statesman so far-sighted and so fair-minded as the present Secretary of State for Foreign Affairs. It remains to be seen whether all the Convention Powers will ratify the new agreement. In any case, next September will see thrown upon the markets the large quantity of Russian sugar above indicated; and as most of it will probably be in the form of inferior crystals, which are suitable for some purposes of consumption in this country, and as the limited protection permitted to the other European nations, parties to the Convention, will be sufficient to divert the Russian sugar from their markets, our sugar refiners may lay their account for a very formidable competition in the markets of the United Kingdom."

Greenock Sugar Statistics.

The following statistics, culled from the same source, give a useful compendium of the effects of bounties; and then of the effect produced by their abolition, an effect which, unfortunately, was disturbed by the short crop of 1904, the consequent rise in prices, and then the big sowings in 1905, which again produced a plethora of beetroot sugar and swamped the market once more.

In 1875 we refined in the United Kingdom nearly a million tons of raw sugar and imported less than 100,000 tons of foreign refined. In 1903 we refined less than 600,000 tons of raw sugar and imported *927,000* tons of foreign refined—all bounty-fed. On the other hand, in 1906 we refined 150,000 tons more raw sugar than we did in 1903, and imported, in 1905, 200,000 tons less foreign refined sugar than we did in 1903.

Unfortunately the big beetroot crop of 1905, caused by the dependance of the world on that crop for its supply of sugar—in other words, caused by the bounties—forced 900,000 tons of foreign refined on our markets in 1906, and nearly 1,000,000 tons in 1907.

Table showing the Total Imports (in tons) of Raw Sugar into the United Kingdom, 1875, and 1902 to 1907.

1875.	1902.	1903.	1904.	1905.	1906.	1907.
925,000 ..	668,000 ..	627,000 ..	731,000 ..	718,000 ..	767,000 ..	743,000

Table showing the Total Imports (in tons) of Raw Sugar into Greenock, 1875, and 1902 to 1907.

1875.	1902.	1903.	1904.	1905.	1906.	1907.
247,000 ..	133,500 ..	107,500 ..	155,000 ..	156,000 ..	179,600 ..	166,300

Table showing the Total Raw Sugar Refined in Greenock, 1875, and 1902 to 1907.

1875.	1902.	1903.	1904.	1905.	1906.	1907.
243,000 ..	126,000 ..	121,000 ..	152,000 ..	144,000 ..	188,000 ..	163,000

Table showing Imports (in tons) of Foreign Refined Sugar into United Kingdom, 1875, and 1902 to 1907.

1875.	1902.	1903.	1904.	1905.	1906.	1907.
Under—100,000 ..	934,000 ..	927,000 ..	875,000 ..	735,000 ..	905,000 ..	980,000

The Australian duties on confectionery, as set forth in their latest tariff, amount to 3d. per lb. under the general tariff and to 2½d. per lb. under the British tariff. This doubles the preference on British goods.

A THEORY OF THE EXTRACTION OF SUGAR FROM MASSE-CUITES.*

By Noel Deerr.

The object of this bulletin is to collect into an accessible form the data requisite for a systematic scheme of sugar boiling, and to establish some simple algebraical formulae connecting purity of masse-cuite and concentration to which it should be boiled to obtain the best results. Incidentally the bearing of these results on the process known as "Crystallization in Motion" and an apparatus known as the "Brasmoscope" is discussed.

Effect of dissolved solids on the Boiling Point.—The boiling point is increased by the presence of dissolved solids and the following important relation connects boiling point, amount of dissolved solid, and pressure under which ebullition occurs. "The elevation of the boiling point due to the dissolved solids is independent of the pressure under which ebullition occurs." For example, under a pressure of one atmosphere water boils at 212° F., and a 75% solution of sugar at 225·2° F. The elevation in the boiling point is then 13·2° F.; under a pressure of 4 inches of mercury (25·9 inches of vacuum) water boils at 125·6° F.; a 75% solution of sugar under the same pressure will then boil at $125{\cdot}6 + 13{\cdot}2 = 138{\cdot}8°$ F. The temperatures at which sugar solutions of different concentrations boil under atmospheric pressure have been determined (see table at end); if then the temperature of a boiling sugar solution be known, and also the pressure under which ebullition occurs, then from the elevation of the boiling point over and above the boiling point of water under the same pressure, the amount of sugar in the boiling mass can be at once found. For example, under a pressure of 4 inches of mercury a sugar solution boils at 159·4° F.; water under this pressure boils at 125·6° F.; the elevation in the boiling point then is 29·8° F.; reference to the table of elevation of boiling points of sugar solutions gives the percentage of sugar at 86·25%.

This relation is the basis of an instrument known as a Brasmoscope or Brixometer.†

Application of the Brasmoscope.—The simplest instance of the use of the brasmoscope lies in its application to low products boiled string-proof; here no sugar separates in the pan as crystals, and the indications of the instrument will now refer to the Brix of the whole mass in the pan. Suppose it has been found by experience that a mass of 50 apparent purity gives the best results when boiled to an apparent Brix, as indicated by the brasmoscope, of 90; when this

* Abridged from Bulletin No. 20 of the Hawaiian Sugar Planters' Association.

† This apparatus has already been described in this Journal.

factor has once been determinod it is an easy matter to boil all subsequent strikes of this purity to the same elevation of the boiling point, and this can, I believe, be done more exactly with the aid of graduated instruments than by the sense of touch of the most experienced sugar maker. The illustration given above demands, of course, that the nature of the non-sugar does not vary, and, for one particular factory, I do not think that this assumption is too far from the truth.

Now in actual work the purity of the masses boiled will vary, and to extend the application of the brasmoscope it is necessary to solve the following problem :—

"To find the connection between the Brix of a masse-cuite and the purity of the mother liquor or molasses, the solubility of sugar in the mother liquor being known."

Let x = Brix of the masse-cuite.

s = solubility of sugar in the mother liquor or molasses.

p = purity of the masse-cuite.

m = purity of the molasses.

Then $(1-x)$ = water in the masse-cuite.

$s(1-x)$ = sugar in solution, *i.e.*, in the molasses.

$x(1-p)$ = total non-sugar or impurities.

(For convenience of calculation these purities are referred to unity instead of to 100 as is usual.)

Then

$$m = \frac{s(1-x)}{s(1-x) + (1-p)x}$$

and

$$x = \frac{s - ms}{s + m - ms - mp}.$$

Now, according to Mr. S. S. Peck's analyses of Hawaiian waste molasses, on an average one part of water dissolves 1·78 parts of sugar and the average true purity of the molasses is 45·8. I have then calculated in Table I. values of x for purities of the masse-cuite (p.) 46-95; when to s and m are given the values 1·8 and 46, this table gives on the data taken the degree Brix to which a masse-cuite must be concentrated, so that after complete crystallization the purity of the mother liquor or molasses is 46. Now from the values in the table it is seen that a masse-cuite of 50 purity will give molasses of 46 purity if concentrated to 80·86 Brix; actually suppose it is found that the best results are obtained when the apparent Brix as shown by the brasmoscope is 86·5; it is now desired to find from the formula or table what should be the Brix as indicated by the brasmoscope when the purity of the masse-cuite is 55.

From the formula or table it follows that a masse-cuite of 50 purity concentrated to 80·86 Brix will give molasses of the same purity as

one of 55 when concentrated to 82·44 Brix. The ratio between these two Brix is 82·44 ÷ 80·86 = 1·0195. Hence the required Brix as indicated by the brasmoscope is 86·5 × 1·0195 = 88·19, *i.e.*, if a masse-cuite of 50 purity gives molasses of 46 purity when concentrated to 86·5 Brix as indicated by the brasmoscope, a masse-cuite of 55 purity will give molasses of the same purity when concentrated to 88·19 as indicated by the brasmoscope.

Now, according to the equation, it is possible by boiling to a sufficient concentration to obtain in one process exhausted molasses; thus a syrup of 90 purity if boiled to a concentration of 95·48 Brix would, on the data on which Table I. was constructed, give molasses of 46 purity. Now from actual experience it is known that with the procedure commonly followed in the Hawaiian Islands four operations are necessary in general to obtain this end; there is no real disagreement between theory and practice but the causes of this are:

1. It is impossible to practically boil any masse-cuite to so high a concentration as 95·48; a masse-cuite so highly concentrated would have no circulation, it would bank up and burn on the coils, and it would be a matter of difficulty to remove it from the pans and to manipulate it afterwards.

2. A very supersaturated solution of sugar would be formed in the final stages, from which, under the ordinary process of cooling at rest, sugar would separate with extreme slowness and in a form not suited to be recovered in the centrifugals.

Actually in practice it is known that the higher the purity of the masse-cuite the higher is the purity of the mother liquor or molasses; this is a natural sequence of the equation and in Table II I have calculated out values of the purity of the mother liquor or molasses when the purity of the masse-cuite varies from 75 to 95 and the Brix of the masse-cuite is constant at 90. This table then connects the purity of the molasses with the purity of the masse-cuite from which they are derived, provided all the masse-cuites are boiled to the same degree Brix; actually, however, the higher the purity the higher is the concentration to which the masse-cuite is boiled.

The amount of sugar then that can be extracted as crystals from a masse-cuite depends on the degree Brix to which the masse-cuite can be boiled, or, conversely, to the least possible amount of water which can be left in the masse-cuite capable of retaining in solution the non-sugar, and it is immaterial, so far as regards the amount of sugar that crystallizes, whether the concentration is done in one or in more operations. This is best shown by a worked out example.

Let there be a syrup of 80 purity, let it be concentrated to a Brix of 90 and let the solubility of sugar in the mother liquor be 2, *i.e.*, for every one part of water in the mother liquor let two parts of sugar be dissolved.

Then the masse-cuite is of composition

Water	10
Sugar in solution	20
Sugar as crystals	52
Non-sugar	18
	100

Now let the 52 parts sugar as crystals be removed leaving 48 parts of first molasses of percentage composition.

Water	20·83	
Sugar	41·66	
Non-sugar	37·50·	100
Brix..	79·17	
Purity	52·63	

and the sugar removed per cent. on that originally present is

$$\frac{100 \times 52}{72} = 72{\cdot}22\%.$$

leaving 27·78% in the molasses.

Now let these molasses be concentrated to a second masse-cuite at 90 Brix and let one part of water hold in solution two parts of sugar.

Then the percentage composition of the second masse-cuite is

Water	10
Sugar in solution	20
Sugar in crystals	27·367
Non-sugar	42·633
	100·00

Now let 27·367 sugar in crystals be removed. Then per 100 sugar originally present there are removed

$$\frac{27{\cdot}367}{47{\cdot}367} \times 27{\cdot}78 = 16{\cdot}07\%.$$

and the total amount of sugar removed in the two operations per 100 sugar originally present is 72·22+16·07=88·29.

Now to find to what Brix the masse-cuite must be boiled in one operation so as to leave the same absolute amount of water in the masse-cuite, we can proceed as follows: In the second masse-cuite above, the non-sugar is 4·2663 times the water and the purity of the original syrup being 80, the sugar in the original masse-cuite is four times as much as the non-sugar. Let x be the water percentage in the masse-cuite boiled in one operation so that the absolute amount of water left is the same as that in the two operations above.

Then

$$x + 4{\cdot}263x + 17{\cdot}0532x = 100$$
$$x = 4{\cdot}482$$

The composition of the masse-cuite boiled to this water content in one operation will be

Water	4·482
Sugar in solution	8·964
Sugar in crystals	67·450
Non-sugar	19·104

and if the 67·450 sugar in crystals be removed, the amount of sugar extracted per 100 sugar in the masse-cuite is

$$\frac{67\cdot450}{76\cdot414} \times 100 = 88\cdot29\%.$$

the same percentage as was obtained before in two operations.

From what has been already said it follows, that if a masse-cuite be boiled to a certain pre-ascertained concentration depending on the purity and be allowed to cool, that eventually all the sugar capable of recovery will crystallize out; it does *not* follow, however, that all this sugar will crystallize out in a form capable of collection in the centrifugals or within a reasonable time. In the first place, owing to lack of contact of crystals already formed with any but a small portion of the mother liquor, sugar that crystallizes on cooling will form new fine crystals incapable of recovery in the centrifugals. In the second place, it is known how long it takes low masses to crystallize; the mother liquor of a first masse-cuite boiled to such a pitch that all the sugar capable of recovery will crystallize is in exactly the same condition as a low grade masse-cuite, and although in the case of a first masse-cuite crystallization will be more rapid owing to the presence of crystals already formed, yet a very considerable time will be taken for a complete separation of the sugar from the supersaturated mother liquor. If, however, the masse-cuite be kept in motion so that the layer or mother liquor in contact with crystals is being constantly renewed, deposition will take place much more readily and the sugar separating will deposit on the crystals already formed; this was the original object of the process known as crystallization in motion.

Crystallization in motion originally was applied to first products only; a masse-cuite was boiled in the usual way to the usual pitch and allowed to cool in motion; this process by allowing sugar held in solution due to high temperature and in supersaturated solution to deposit on crystals already formed gave an increased *rendement* in first product but in no wise could it obtain a complete desugarization of a pure masse-cuite unless the concentration was carried to the degree indicated by the formula

$$\frac{s - ms}{s + m - ms - mp}$$

and it has already been noted that so high a concentration is for mechanical reasons impossible. Following on this came the idea of

working with masses of purity so reduced by the addition of molasses that on concentration to that water content where all the sugar capable of recovery crystallized, the masse-cuites were capable of ready manipulation and after cooling in motion on curing gave "first sugar and molasses," *i.e.*, a complete commercial *rendement* without the interposition of low grade sugars.

A complete crystallization in motion or first sugar and molasses process may then be defined as "a scheme in which the purity of masse-cuites is reduced to such a point that they are capable of practical manipulation when concentrated to that point when the water left is only just sufficient to hold in solution the non-sugar, combined with the cooling of the masse-cuites in motion whereby the deposit of sugar from supersaturated solution is accelerated and takes place on crystals already formed."

The technique of the various processes devised and used to this end may be summarized thus.

1. A masse-cuite is boiled from syrup alone and concentrated as far as possible; unexhausted molasses from a previous operation which have been diluted and heated so as to dissolve any fine grain are then taken into the pan, the whole mixed masse-cuite concentrated to the proper point, struck out and cooled in motion.

2. The process is conducted as above save that exhausted molasses are introduced; in this scheme the exhausted molasses should leave the centrifugals on curing at the same purity as that at which they entered the pan; they do not aid in the exhaustion of the syrup masse-cuite, but only act mechanically as a medium in which the crystals swim.

3. The mixture of syrup and molasses is made without the pan, the formation of grain being obtained from syrup alone. As the sugar deposits, the purity of the mother liquor decreases, and it is the object of the scheme to avoid increasing from time to time the purity of the mother liquor by charging in pure syrup, and to regulate the proportions of syrup and molasses charged in as the purity of the mother liquor falls.

4. The Java process which is now used in several factories in the Hawaiian islands, and consists essentially of two strikes; the first of fairly high purity, which is cooled in motion for about 12 hours, and the second at a purity of about 60, which is cooled in motion for from 48 to 72 hours, and from which exhausted molasses are obtained.

5. The Bock process in which a strike was boiled from syrup alone and run into crystallizers; about one-third of this strike was left in the crystallizer and on to this was struck a strike boiled from molasses obtained from a previous operation, and the whole then cooled in motion.

6. A strike of molasses is boiled string-proof and to the concentration required to yield exhausted molasses; into the pan immediately before the completion of the boiling is taken a quantity of sugar which is thoroughly mixed with the contents of the pan, after which the whole is struck out and cooled in motion; the amount of sugar crystals taken into the pan as "priming" is from 25 to 30 per cent of the masse-cuite.

Whichever one of these schemes be used it is apparent that they all depend for their success upon the control of the water content of the masse-cuite.

Application of the Brasmoscope to Masse-cuites Boiled to Grain.—The application of the brasmoscope readings to control the water content of masse-cuites boiled to grain is complicated in that the instrument does not give the Brix of the masse-cuite as a whole but of that of the mother liquor; what is required to be known may be expressed "What shall be the Brix of the mother liquor in the pan at the moment of observation so that on cooling exhausted molasses result," and algebraically the problem can be solved thus:—

Let the solubility of sugar in molasses at a low temperature be s and let it be s' at a more elevated temperature; it is required to find what must be the Brix when the solubility is s' so that the purity is m when the solubility is s. Let x be the Brix of the molasses when the solubility of sugars is s.

Then

$$1 - x = \text{water}$$

$$s(1 - x) = \text{sugar}$$

and

$$m = \frac{s(1 - x)}{x}$$

whence

$$x = \frac{s}{s + m} \qquad (1)$$

Now let the solubility of sugar change to s', all other factors remaining the same.

The absolute amount of sugar in solution now is $s'(1 - x)$, the water and non-sugar remaining the same.

If the Brix be now denoted by x',

$$x' = \frac{s'(1 - x) + \{x - s(1 - x)\}}{s'(1 - x) + \{x - s(1 - x)\} + 1 - x}$$

For s put $s + d$, d being the difference in the solubility of sugar at the two temperatures.

Then

$$x' = \frac{d + x - dx}{1 + d - dx}$$

But x has already been shown to be equal to $\dfrac{s}{m + s}$

Making the substitution

$$x' = \frac{d + \dfrac{s}{m+s} - \dfrac{ds}{m+s}}{1 + d - \dfrac{ds}{m+s}} = \frac{s - dm}{s + m - dm} \qquad (2)$$

As a numerical example let the solubility of sugar be 1·8 and let molasses of 46 purity be required; the Brix of these molasses will be from equation (1)—

$$\frac{100 \times 1{\cdot}8}{1{\cdot}8 + {\cdot}46} = 79{\cdot}64$$

Now let the solubility of sugar become 2·5 so that d is ·7. The Brix of the molasses now is from equation (2)—

$$100 \times \frac{2{\cdot}5 - {\cdot}7 \times {\cdot}46}{2{\cdot}5 + {\cdot}46 - {\cdot}7 \times {\cdot}46} = 82{\cdot}57$$

Unfortunately the solubility of sugar in the hot mother liquor (s' in the equation established above) in the pan can not be exactly known; it is affected by the temperature prevailing, by the presence of non-sugar, and by the degree of supersaturation. Now, at the temperature 40° C., at which it is customary to cure masse-cuites boiled to grain and cooled in motion, the solubility of sugar in water is 2·38, and at the temperature 70° C., which is approximately that of the masse-cuite in the pan, the solubility is 3·20; the ratio of these is 1·34. Previously I took the solubility of sugar in Hawaiian exhausted molasses as 1·8, that is to say, at the normal temperature here say 27° C.; between 27° C. and 40° C. the solubility of sugar in water increases in the ratio 1·11, and hence at 40° C. I take the solubility of sugar in Hawaiian molasses as $1{\cdot}11 \times 1{\cdot}8 = 1{\cdot}998$, and at 70° C. $1{\cdot}998 \times 1{\cdot}34 = 2{\cdot}68$; cutting off the decimals, the values of s and s' in the equation established above will then be taken as 2·0 and 2·7.

Now, owing to supersaturation the lowest solubility possible in the pan at the temperature of 70° C. will be 2·7, and it may be considerably higher. I have then calculated out values of the equation

$$\text{Brix} = \frac{s - md}{s + m - md}$$

for values of $s = 2{\cdot}0$, $d = 0$ to $1{\cdot}3$ ($s' = 2{\cdot}7$ to $4{\cdot}0$) and $m = 38$ to 50. These are given in Table III. below. In the vertical column on the left-hand side are entered the solubilities of sugar in the molasses in the pan; in the horizontal caption are entered the values of m from 38—50; the figure at the intersection of a vertical and horizontal line gives the degree Brix of the molasses in the pan, so that when the solubility of sugar becomes 2·0, molasses of the purity in the column selected will result.

Example.—The solubility of sugar at the moment of observation is 3·0, and it is desired to obtain molasses of 40 purity when the solubility is 2·0; at the intersection of the line 3·0 and 40 is the figure 85·07, *i.e.*, the Brix of the molasses in the pan must be 85·07.

As I pointed out in dealing with the application of the brasmoscope to masse-cuites boiled string-proof, it is impossible to state beforehand what the indication of the brasmoscope should be, and the brasmoscope indications must be systematically compared with the actually recorded results in the factory; when once the brasmoscope indications corresponding to molasses of a satisfactorily low purity are obtained, then it should be possible to reproduce those conditions more exactly than can be done by the senses of sight and touch.

The process of exhausting rapidly low-grade masse-cuites, mentioned above as No. 6, would appear to be a scheme to lend itself readily to a very complete control, as it would only be necessary to determine the proper concentration of the low-grade masse-cuite before taking in the sugar used as "priming," as had already been indicated when dealing with the application of the brasmoscope to masse-cuites boiled string-proof. Actually I have never seen this scheme worked, but I believe it is in considerable vogue in beet sugar factories.

Below I call attention to one or two points of interest not previously mentioned:—

1. *Size of crystals.*—The rate at which sugar deposits from supersaturated solution is intimately connected with the area of the sides of the crystals which in a given time come in contact with the mother liquor; the smaller the grain the larger is the area of the sides of the crystals and hence desugarization of a supersaturated mother liquor will take place more rapidly with a small grain sugar than with a large one.

2. *Rate of cooling.*—As a general rule when a grained masse-cuite is discharged, the supersaturation is relatively high; if such a masse-cuite be quickly cooled the deposit of sugar takes place with such suddenness that the sugar now separating from solution does not deposit on the crystals already present but goes to form new crystals; in these islands, I believe, the crystallizing tanks are plain and are not provided with jackets, so that means do not exist for controlling the rate at which the masse-cuite cools. In beet sugar factories, I believe, great attention is paid to this point and it is general to construct crystallizing tanks with jackets into which steam or water may be admitted; the temperature of the masse-cuite is allowed to fall very slowly at first until (largely aided by the movement of the

masse-cuite) the supersaturation is decreased; after which the rate of cooling is allowed to become more rapid. The rate at which a body cools is, with certain limitations, proportional to the excess temperature, and with unjacketted tanks the rate of cooling will be greatest in the earlier stages—precisely the reverse of what is demanded by the above argument.

3. *Remelting low sugars.*—When low sugars are remelted the purity of the masse-cuite is increased and it has already been shown that an increased purity in the masse-cuite implies an increased purity in the molasses; on these grounds then remelting low sugars is not a process to be recommended and it should rather be the object of the sugar maker to strive to suppress low products altogether rather than to eliminate them by the process of remelting.

Summary.

1. The amount of sugar crystallized depends on the absolute amount of water left in the masse-cuite.

2. It is immaterial in so far as regards the amount of sugar that crystallizes if the total amount of water evaporated from a syrup be removed in one or in more operations.

3. A certain amount of water has to be left in a masse-cuite to enable it to be manipulated; with masse-cuites of high purity to obtain in one boiling all the sugar that can crystallize, the concentration has to be so high that manipulation becomes impossible.

4. By lowering the purity of masse-cuites the concentration corresponding to the point at which exhausted molasses result may be obtained, the masse-cuites at the same time being sufficiently fluid to handle.

5. By allowing these masse-cuites of reduced purity to cool in motion, the time taken for sugar to separate from supersaturated solution is diminished and under careful control of the rate of cooling, the sugar deposits on the crystals already formed.

6. Systematic observations of the elevation of the boiling point of the mass in the pan form a valuable guide to the operator.

Finally I wish to emphasize that the brasmoscope is not in any way intended to supersede the craft skill of the experienced sugar maker; it is intended to be used rather as an adjunct and a guide, and to substitute a definite scientific relation for the varying senses of sight and touch.

TABLE I.

Values of the expression $100 \times \frac{s - ms}{s + m - ms - mp}$ for values of s 1·8, and m ·46, and of p ·46 to ·95:—

p.		p.		p.	
·46	79·65	·63	85·09	·80	91·35
·47	79·95	·64	85·44	·81	91·75
·48	80·25	·65	85·79	·82	92·15
·49	80·56	·66	86·14	·83	92·55
·50	80·86	·67	86·49	·84	92·96
·51	81·17	·68	86·85	·85	93·37
·52	81·49	·69	87·21	·86	93·79
·53	81·80	·70	87·57	·87	94·20
·54	82·12	·71	87·93	·88	94·62
·55	82·44	·72	88·30	·89	95·05
·56	82·76	·73	88·67	·90	95·48
·57	83·07	·74	89·04	·91	95·92
·58	83·42	·75	89·42	·92	96·35
·59	83·75	·76	89·80	·93	96·79
·60	84·08	·77	90·18	·94	97·24
·61	84·42	·78	90·57	·95	97·69
·62	84·76	·79	90·96		

TABLE II.

Connecting purity of masse-cuite and purity of resulting molasses when the Brix of the masse-cuite is constant at 90 and solubility of sugar in molasses is 2·0:—

Purity Masse-cuite.	Purity Molasses.	Purity Masse-cuite.	Purity Molasses.
75	44·44	86	58·82
76	45·45	87	60·60
77	46·51	88	62·50
78	47·62	89	64·51
79	48·78	90	66·67
80	50·00	91	68·96
81	51·28	92	71·43
82	52·63	93	74·07
83	54·06	94	76·92
84	55·55	95	80·00
85	57·14		

TABLE III.

Solubility of Sugar in Pan.	Purity of Molasses with Solubility, 2·0.												
	38	39	40	41	42	43	44	45	46	47	48	49	50
2·7	84·93	84·65	84·37	84·14	83·48	83·37	83·31	83·05	82·80	82·55	82·30	82·06	81·81
2·8	85·15	84·88	84·62	84·35	84·09	83·83	83·58	83·33	83·09	82·85	82·61	82·37	82·14
2·9	85·37	85·11	84·85	84·59	84·34	84·09	83·85	83·61	83·37	83·13	82·90	82·65	82·46
3·0	85·58	85·33	85·07	84·82	84·58	84·34	84·10	83·87	83·64	83·42	83·19	82·98	82·76
3·1	85·79	85·54	85·29	85·05	84·81	84·58	84·35	84·13	83·91	83·69	83·47	83·26	83·05
3·2	85·99	85·75	85·51	85·27	85·04	84·82	84·60	84·38	84·16	83·95	83·74	83·53	83·33
3·3	86·18	85·95	85·72	85·49	85·26	85·04	84·83	84·62	84·41	84·20	84·00	83·80	83·60
3·4	86·37	86·14	85·91	85·69	85·47	85·26	85·05	84·85	84·65	84·45	84·25	84·06	83·87
3·5	86·55	86·33	86·11	85·89	85·68	85·48	85·27	85·07	84·88	84·70	84·50	84·31	84·13
3·6	86·73	86·52	86·31	86·09	85·89	85·69	85·49	85·29	85·10	84·92	84·73	84·55	84·37
3·7	86·90	86·69	86·49	86·29	86·09	85·89	85·69	85·50	85·32	85·14	84·97	84·79	84·62
3·8	87·07	86·87	86·67	86·47	86·27	86·08	85·89	85·71	85·53	85·36	85·18	85·02	84·85
3·9	87·24	87·04	86·84	86·65	86·46	86·27	86·09	85·92	85·74	85·57	85·40	85·23	85·07
4·0	87·40	87·20	87·01	86·83	86·64	86·46	86·11	86·11	85·94	85·78	85·61	85·45	85·29

TABLE OF THE BOILING POINTS OF WATER UNDER REDUCED PRESSURE.

Pressure in inches of Mercury.	Vacuum in inches of Mercury.	Boiling Point F°.	Pressure in inches of Mercury.	Vacuum in inches of Mercury.	Boiling Point F°.
1·0	28·9	79·6	3·5	26·4	120·8
1·1	28·8	82·5	3·6	26·3	121·8
1·2	28·7	85·2	3·7	26·2	122·8
1·3	28·6	87·7	3·8	26·1	123·8
1·4	28·5	90·0	3·9	26·0	124·7
1·5	28·4	92·2	4·0	25·9	125·6
1·6	28·3	94·2	4·1	25·8	126·6
1·7	28·2	96·2	4·2	25·7	127·5
1·8	28·1	98·1	4·3	25·6	128·3
1·9	28·0	99·8	4·4	25·5	129·2
2·0	27·9	101·5	4·5	25·4	130·0
2·1	27·8	103·1	4·6	25·3	130·8
2·2	27·7	104·7	4·7	25·2	131·6
2·3	27·6	106·2	4·8	25·1	132·4
2·4	27·5	107·6	4·9	25·0	133·2
2·5	27·4	109·0	5·0	24·9	133·9
2·6	27·3	110·4	5·1	24·8	134·7
2·7	27·2	111·7	5·2	24·7	135·4
2·8	27·1	112·9	5·3	24·6	136·2
2·9	27·0	114·7	5·4	24·5	136·9
3·0	26·9	115·3	5·5	24·4	137·6
3·1	26·8	116·4	5·6	24·3	138·3
3·2	26·7	117·6	5·7	24·2	138·9
3·3	26·6	118·7	5·8	24·1	139·6
3·4	26·5	119·8	5·9	24·0	140·3

Table of the Elevation of the Boiling Point of Sugar Solutions.

(Claassen-Frentzel, Deutsche Vereinzeitschrift, 1893, p. 267.)

Per cent. Sugar.	Elevation of the Boiling Point F°.	Per cent. Sugar.	Elevation of the Boiling Point F°.
75·	13·2	86·5	30·4
75·5	13·7	86·75	31·1
76·	14·2	87·	31·8
76·5	14·8	87·25	32·5
77·	15·3	87·5	33·2
77·5	15·8	87·75	33·9
78·	16·4	88·	34·6
78·5	16·9	88·25	35·3
79·	17·5	88·5	36·0
79·5	18·0	88·75	36·7
80·	18·6	89·	37·5
80·5	19·3	89·25	38·3
81·	19·9	89·5	39·1
81·5	20·5	89·75	39·9
82·	21·2	90·	40·7
82·5	22·0	90·25	41·5
83·	22·7	90·5	42·4
83·5	23·6	90·75	43·2
84·	24·7	91·	44·1
84·5	25·7	91·25	45·1
85·	26·8	91·5	46·3
85·5	27·9	91·75	47·7
86·	29·2	92·	50·2
86·25	29·8		

THE USE OF BLANKIT IN THE SUGAR INDUSTRY.

There has always been a great demand in the sugar industry for a good decolourising agent and at different times a number of preparations have been recommended which were to have wholly or partially taken the place of animal charcoal, but after a short time most of these have disappeared from the market, having failed to answer the requirements of the trade.

However, in our issue of March last there appeared a communication from Mr. Noel Deerr mentioning the use of *sodium hydrosulphite* in the preparation of cane products for polarimetric assay, and he referred specially to a new product which had just appeared on the market under the name of "Hydrosulphite B.A.S.F. Powder Z," and which was being applied on a large scale in sugar manufacture.

We have now been placed in possession of further particulars of this agent, which it appears is manufactured by the Badische Anilin- & Soda-Fabrik, Ludwigshafen a/Rhein, Germany, under the trade name of "Blankit." From this firm we learn that this bleaching agent has secured a rapid introduction into the various branches of the sugar industry at home and abroad and has met with immediate and permanent success. As it will no doubt interest the expert to have further information regarding this product, we give below a detailed description of its composition and application, as well as particulars of some experiments carried out by the well-known German authority, Dr. Herzfeld, on sugars treated with Blankit.

Blankit is the pure sodium salt of hydrosulphurous acid ($Na_2S_2O_4$) and comes into the market as a white powder, readily soluble in water, which, if protected from moisture, will keep for an unlimited time in any climate.

The application of Blankit is the simplest conceivable. The most rational procedure is to make the addition to the sugar syrup in the vacuum pan during concentration, the powder being best introduced in a dry form through a suitable inlet tap. Generally 1 to 5 lbs. Blankit are used for a boiling which yields 10,000 lbs. finished sugar, more than 5lbs. being required only for very dark syrups. A portion of the Blankit necessary for the whole boiling must be added before granulation; the rest is added later in proportion to the syrup additions and so long as the mass in the pan is capable of being well mixed. The decolourising of the syrup is instantaneous and in spite of the small quantity of bleaching preparation taken, the effect is very striking. If for some particular reason it is not practicable

to use the Blankit in powder form a solution may be prepared in *cold* water. One part Blankit is dissolved in ten parts water to which has been previously added a little quick-lime, soda or caustic soda. It must be remembered, however, that Blankit solutions cannot be kept for long; they lose in decolourising power through oxidation by the air and must therefore always be made up fresh immediately before use.

The advantage of Blankit consists not only in its decolourising action but also in its property of diminishing the viscosity of the syrup, thus facilitating and improving the crystallization. Under some circumstances this property may be quite as valuable for the sugar industry as the bleaching property of Blankit, and it has already been the subject of a number of scientific investigations, the results of which have been published in various technical journals abroad.* A possible explanation of the phenomenon is that the sodium hydrosulphite which in exerting its reducing action is converted by oxidation into sodium bisulphite($Na_2S_2O_4 + O + H_2O = 2NaHSO_3$), at the same time combines with a portion of the lime forming double salts of sodium and calcium hydrosulphite.

An objection that might conceivably be made against the use of Blankit is that the increase in the quantity of "Soluble Ash" would favour the formation of molasses. There is, however, no justification for such a fear, the quantity of Blankit necessary for decolourising purposes being too insignificant to have any influence. As a matter of fact in spite of the already very extensive use of Blankit, no complaint under this head has up to now been heard of.

Further it must be borne in mind that when an unnecessary excess of Blankit is used, the quantity of reducing substances is naturally increased, as that portion of the strongly reducing Blankit which is in excess remains in the syrup in an unaltered form This reduction is then erroneously ascribed to the formation of invert sugar, whereas Blankit by reason of its chemical properties is not really capable of forming invert sugar, a fact which has been observed with perfect agreement by several investigators.†

It is a remarkable phenomenon that the strong decolourising effect produced on sugar syrups by Blankit can be partially or even wholly

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* Nowakowski, Oesterr.-Ungar. Zeitschrift für Zuckerindustrie und Landwirtschaft, No. 11, 1907, pages 330-335.
Gazeta Cukrownicza, XIVth volume, 1907, No. 27, page 397.
Senitzki, Bote der Zuckerindustrie, 1906, No. 49.
Schnell, Centralblatt f.d. Zuckerindustrie, XIV. 1906, page 1252.
Journal des Fabricants de Sucre, 1906, No. 7 and 9.

† Herzfeld, Zeitschrift des Vereins der Deutschen Zuckerindustrie, 1906, page 637.
Wassiljeff, Journal der Kiewer Technol. Gesellschaft, 1906.
Nowakowski, Gazeta Cukrownicza, XIVth Volume 1907, page 397.

lost on filtering over animal charcoal This peculiarity demands, therefore, that the Blankit is only added *after filtration* and, as above mentioned, the *most rational application is in the vacuum pan*. Thus employed Blankit enables the refiner to dispense for the most part with the char, if not to do without it altogether. This method of working was first tried by Nowakowski* who thereby affirmed that masse-cuites decolourised by Blankit only could be worked up perfectly well, and that the sugar finally obtained was of a finer and more brilliant white than that filtered over charcoal. The constitution of the syrup is, however, of essential importance for the success of this exceedingly simple and reasonable process. According to Nowakowski a decrease in the alkalinity of the syrup is particularly necessary or the resulting sugar comes out yellow in appearance.

The expert will, no doubt, be interested in learning the details of an experiment carried out on masse-cuites and mother-liquors by Dr. Herzfeld in the Institute für Zucker-Industrie. The materials were obtained from a very important sugar refinery where Blankit is regularly used. The experiment was made with four masse-cuites and the mother-liquors of the same:—

(1.) Cube masse-cuite without Blankit.
(2.) ,, ,, with ,,
(1100 gr. Blankit per 14,000 kilo masse-cuite.)
(3.) Loaf masse-cuite without Blankit.
(4.) ,, ,, with ,,
(1100 gr. Blankit per 14,000 kilo masse-cuite.)
(1a.) Mother-liquor of cube masse-cuite without Blankit.
(2a.) ,, ,, ,, ,, with ,,
(3a.) ,, ,, loaf ,, without ,,
(4a.) ,, ,, ,, ,, with ,,

A complete analysis was made of each of these samples.

In expressing his opinion on this experiment Dr. Herzfeld reports that the Blankit acted favourably in every case without the ash percentage, reducing power, alkalinity or purity having been in the least disadvantageously affected. The variations in the results as regards the different constituents of the comparative samples are in every instance within the limits of experimental error.

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*Nowakowski, Oesterr.-Ungar. Zeitschrift für Zuckerindustrie und Landwirtschaft, No. 11, 1907, pages 330-335.

Analysis of the Masse-cuites.

Number.	Polarization.	Water.	Ash.	Purity factor.
		Per cent.	Per cent.	
1. Cube Masse-cuite without Blankit	91·0	8·78	0·09	99·76
2. The same with Blankit ..	91·30	8·22	0·09	99·48
3. Loaf Masse-cuite without Blankit	89·30	9·60	0·09	98·78
4. The same with Blankit ..	90·20	8·48	0·08	98·56

Number.	Reducing power per 10 gr.	Alkalinity per 100 gr. Phenol-phthalein.	Colour in Stammer's degrees 100 gr. in 100 gr. water.	Colour after concentrating to one-half (100° C.) and filling up to the original volume.
	mg. Cu.	Per cent. CaO.		
1. Cube Masse-cuite without Blankit	40	0·01	4·6	4·6
2. The same with Blankit ..	40	0·01	3·5	3·5
3. Loaf Masse-cuite without Blankit	44	0·007	8·5	8·5
4. The same with Blankit ..	44	0·005	6·2	6·5

Analysis of the Mother-Liquors.

Number.	Polarization.	Water.	Ash.	Reducing power per 10 gr.
		Per cent.	Per cent.	mg. Cu.
1a. Mother-liquor from cube masse-cuite without Blankit	66·00	33·43	0·02	38
2a. The same with Blankit..	60·40	39·05	0·02	39
3a. Mother-liquor from loaf masse-cuite without Blankit	68·60	30·92	0·04	41
4a. The same with Blankit..	68·00	31·56	0·04	41

Number.	Purity factor (apparent)	Degrees Brix.	Alkalinity per 100 gr. Phenol-phthalein.	Colour in Stammer's degrees.	Colour after concentrating to one-half (100° C.) and filling up to the original volume.
			Per cent.		
1a. Mother-liquor from cube masse-cuite without Blankit	99·10	66·6	0·014	28·5	28·5
2a. The same with Blankit..	99·34	60·8	0·009	13·5	15·4
3a. Mother-liquor from loaf masse-cuite without Blankit	99·42	69·0	0·014	62	62
4a. The same with Blankit..	99·27	68·5	0·012	43·5	46

QUEENSLAND.

The Government Central Sugar Mills.

The third annual report on the Government Central Sugar Mills in Queensland was issued during the past autumn, and favourable progress has again been recorded. So far seven mills, at one time under the control of the Government Treasurer, have discharged all their liabilities, and have passed again under private control. The last one to gain this liberty has been the Racecourse Mill.

Four mills still remain in possession of the Treasurer—Proserpine, Gin Gin, Mount Bauple, and Nerang—and in view of the possibility of their final redemption, steps were recently taken to ensure that when these mills also passed out of the hands of the State new companies should be formed which should include all those outside cane growers who had contributed in no small degree to the success of the ventures when in State hands. It was therefore necessary to formulate satisfactory terms with the old companies and without having recourse to the law courts. As, however, the mortgagors could not agree among themselves as to a final basis, the Comptroller drafted a final proposal of settlement, which was approved of by the Treasurer. This was finally accepted on behalf of the several directorates, to the satisfaction of all parties. As a consequence, when these mills pass out of the Treasurer's hands they will be controlled by new companies, which will include all the cane suppliers, and no others, and each grower's interest and share ownership in the mills will be proportional to his guaranteed supply of cane, according to conditions that shall be determined upon.

The Work at the Four Mills during the Year 1906-7.—The number of cane growers has steadily increased, the latest figures being 357, as against 198 in 1903, the year the Treasurer went into possession. Proserpine has had the largest increase over the previous year, viz., 51, and already 33 new settlers are preparing to become cane suppliers, thus bringing up the total for next year to at least 198.

The rainfall has been far in excess of the average, varying from 86·49 inches at Proserpine to 61·50 inches at Nerang. The crop results have been—

	Tons.		Tons.
Proserpine..	43,168	Mount Bauple	25,125
Gin Gin..	48,136	Nerang	10,936

These figures represent record crops manufactured by each of these mills since they have been in operation. Attention is drawn to the character of the rainfall in order that the bearing of that factor on these results may be duly estimated. The rainfall was not only far above the average, but was also specially favourably distributed over the months when the growth is normally at its maximum.

The introduction of new varieties of cane into the localities of the mills is definitely raising the quality of the crops. These varieties

were obtained from the Mackay Experiment Station, where their values are ascertained before they are distributed. Each of the mills has procured promising varieties, and is having them grown for distribution amongst the canegrowers.

The removal of colour labour, and the substitution of white labour, has notably changed the conditions not only in the mills, but also in respect of the outdoor part of the work. This relates particularly to the matter of procuring firewood. Formerly cord-wood was cut by the Kanaka, and at very considerably less than the present cost. The fuel has now to be provided by the use of white labour. This has largely discouraged the farmers, and held them from contracting to deliver wood, on account of the greater cost. The farmers, moreover, are more wholly engaged in personally taking care of their crops on account of the greater cost of doing the work by hired white labour. As a consequence of the changed situation, the mills are having to arrange directly for cutting and haulage of the firewood by white labour. This results, first, in the employment of large numbers of white men during the off season; and, further, in holding the workmen in the district ready for the next crushing season; and it will finally result in the more or less permanent settlement of numbers of men, with homes and allotment areas, around each mill as "regular hands." In proportion as this transpires will the labour question become further assisted in its solution, and the agricultural situation will also be rendered more permanent and secure.

Expenditures are required each year in renewing worn-out parts of the plant; in the addition of parts with a view to arriving at a better balance between the several stages and branches of the plant; in providing "spares" so that a maximum service dare be taken from each part with safety. Especially in the crushing department, spare roller provision is being made in each mill. This is being done, not only to guard against loss of time if "breaks" occur, but also that rollers can be kept ready grooved to take the place of those that have "worn smooth." The Comptroller has instructed each of the mills that have large crops to handle to be ready to put in the spares, or to re-groove, in the middle of the season. It is the last half of the crop that is usually the richest in sugar, and which is the most difficult to crush, by reason of the harder and drier state of the cane, and for the handling of which, and the getting out of the sugar, the rollers require to be in the sharpest and best condition.

Each year renewed attention is given to the governing factor of *clarification.* The Comptroller wants steam power ample for all other purposes, and also to be able to *macerate with cold water.* Tests conducted personally some time ago showed that the extraction co-efficient of cold water is almost equal to that of hot water; and that cold water extracts a less proportion of impurities relative to

the sugar extracted, which factor determines the proportion of recoverable sugar. With cane of relatively low purity, which obtains at most of the mills under the Control, this is a matter of high importance.

In the clarification the practice is being adopted, where practicable, of taking the limed juice into the clarifiers in its cold state. As the result of tests made some long time ago, it was demonstrated that the best clarification, especially of relatively low purity juices, is obtained by bringing the cold juices gradually to a high temperature, and finally to a boil in the clarifiers. The undisturbed state of the juice, as it rises to the high temperature, allows the impurities to rise in a more solid blanket to the top, and to be swept off without breaking, leaving a clear juice beneath. When the juice goes first into and through the "heater," in which course the heat is enough to coagulate certain of the impurities, and is then violently discharged into the clarifiers, a visibly more imperfect clarification results. Unfortunately, the equipment at some of the mills is not adequate to allow of this practice being followed. At the Gin Gin Mill, the manager, Mr. Desplace, reports: "Your instructions respecting the taking of the juice cold into the clarifiers were fully carried out. The results were excellent. Unfortunately, we cannot dispense with the heater until more clarifier capacity is put in." The changes in methods of treating the juices are pointing out the further additions to the mill equipment that are required in order that the best work can be done. In the report of last year, the Comptroller remarked upon the "high loss of sugar due to preventible causes" in the Mount Bauple Mill. Those causes received the Comptroller's very close attention during the last crushing. As a result, the losses have been reduced by between 5 per cent. and 6 per cent. upon the whole output as compared with previous years. These "preventible causes" have, doubtless, operated ever since the mill began operations, and have only been located since the Control has checked the mill operations by the laboratory. There is yet room for some further improvement with the aid of additional crushing power.

Very considerable work has been done upon *Tramways*, in order to render the carrying power more adequate to necessities at each mill. At the Proserpine, portable tram extensions have been made into several new localities. Three miles of heavier rails have been purchased to substitute portable tramline now in use, next year, when the portable line will be moved out into new areas.

In the report of last year, it was stated, in connection with the Mount Bauple Mill, "A tramline will be constructed connecting the mill with the Government railway at Gundiah. The line will be Government gauge, and the Government rolling-stock will be able to deliver cane in the mill yard, and load sugars at the mill sugar-room for through shipment." This tramline was proposed by the Comptroller, and approved by the Treasurer, on grounds that have been

explained in previous statements, the main reason being that the supply of cane by the lands within the locality, and contiguous to the Bauple Mill, is limited, the maximum supply obtainable being too small to give the mill an economic length of crushing season; and that it is indispensable, if the mill in the average of years is to pay, that further cane supplies shall be brought in from outside localities.

MANUFACTURING RESULTS.

The statement of the manufacturing results at the mills is on the whole fairly satisfactory, but the losses of sugar leave something yet to be desired, although it must be added they have been appreciably reduced during the last year or two.

The following table gives the losses of sugar at each mill during the season 1906-07, as compared with 1905-06. These losses are expressed in terms representing—first, the standard of quality of 88 per cent. N.T., which is still the common standard in use; and, second, the standard of 100 per cent., or pure sugar. The latter is the true statement. The polariscopic statement of the sugar in the cane entering the mill is upon the standard of 100 per cent.; therefore the statement of sugar lost requires to be determined by the same standard:—

TABLE OF LOSSES.

Mills.	1906.		1907.	
	On the basis of 100 per cent. (Pure sugar.)	On the basis of 88 per cent. N.T. (Raw sugar.)	On the basis of 100 per cent. (Pure sugar.)	On the basis of 88 per cent. N.T. (Raw sugar.)
	Per cent.	Per cent.	Per cent.	Per cent.
Proserpine	21·26	18·70	20·65	18·17
Gin Gin	25·89	22·78	26·20	23·05
Mount Bauple....	29·11	25·61	22·60	19·88
Nerang..	....	....	29·85	26·26

It has to be understood that the Nerang Mill made white sugars for direct consumption, the other mills making "raws" for refining.

The Nerang Mill has done extremely improved work. The use of chemicals in making white sugar results in a destruction of sugar; yet the loss was only $3\frac{1}{2}$ per cent. more than at Gin Gin, where a raw sugar of very moderate quality was made.

There is still an actual margin for improvement by all of the mills with but little change in their present equipment. That margin, however, is small. No further great recovery of sugar can be effected by the present crushing power in each mill. At present each mill is doing almost its best, with the aid of maceration, which lies between 18 per cent. and 35 per cent. Even if it were good practice, the maceration cannot be increased, because the following stages in the

manufacture could not keep out of the way of the rollers if more water were used. The only remaining means of reducing the losses will be a costly one. More crushing power is required, either in the form of additional and heavier rollers or preparing plants, or by the combination of these plants with the heavier rollers. With greater crushing power a higher extraction of sugar, with the same or even a lowered amount of maceration, would be obtained, and without putting any increased work upon the evaporating vessels of the mill. A maximum of pressure with a minimum of maceration is the end to be sought. It not only means a higher extraction, it will secure a greater expression of the natural juice; and that finally means a juice of a higher quality, and from which a greater proportion of the sugar in the juice is obtainable.

CANE USED TO MAKE ONE TON OF SUGAR.

	Proserpine. Tons.	Gin Gin. Tons.	Mount Bauple. Tons.	Nerang. Tons.
Cane manufactured	43,168	48,136	24,126	10,936
Sugar made (100 per cent. purity)	4,611·4	4,431·0	2,571·1	1,056·1
Sugar made (88 per cent. N.T.)	5,246	5,035	2,921	1,200
Tons of cane to 1 ton sugar (88 per cent. basis)	8·22	9·56	8·26	9·11
Tons of cane to 1 ton sugar (94 per cent. basis)	8·78	10·21	8·83	9·73
Tons of cane to 1 ton sugar (100 per cent. basis)	9·34	10·86	9·38	10·35

In order to exercise any correct judgment in respect of the figures set forth in the above table, and of the relative quality of the work done by the respective mills, it is necessary to consider these final data in relation to the figures which show the "sugar in the cane," and the "purity of the juice," of the cane delivered at each mill:—

Mills.	Sugar in the cane. Per cent.	Purity of the juice. Per cent.
Proserpine	13·46	88·99
Gin Gin	12·40	84·70
Mount Bauple	13·78	89·53
Nerang	13·82	87·85

These further data show, in the first place, that the Gin Gin cane, by reason of its lower quality, could not, even had the handling been equally good, have given the same results in sugar that were obtainable at the other mills. The data also bring out into prominence the superior work still being done by the Proserpine Mill in comparison with the Mount Bauple results. The Proserpine Mill, with notably less sugar in the cane and a slightly lower purity of juice, made a ton of sugar with a little less cane than Mount Bauple Mill. When compared with last year, these results generally are satisfactory; but the Comptroller is aware of that which should still be attained, and this consideration must govern future effort.

Financial Position of the Mills.

It will be of value, at this time, if a statement is furnished setting forth, in tabular form, the financial operations of all the central mills in their relations with the State, and showing the rate and proportion of liquidation that has been made by each mill of its obligations to the Treasury. Such a financial recapitulation can be advisedly resolved into two periods :—

I. From the establishment of the greater number of the mills in 1893 to 31st December, 1903, at which time the Treasurer entered into actual possession of six of the mills.

II. From 31st December, 1903, to 30th June, 1907, during which period the six mills in the possession of the Treasurer, have been under the *control* of the Bureau of Central Mills.

In the first period 14 mills were involved, and the amount of money advanced to them was almost £575,000. At the end of those years every mill was still owing money to the Treasury, eight of them owing more than at the date of their establishment; and the total indebtedness to the Treasury on December 31st, 1903, was greater by some £5,500 than the sum of the moneys that had been advanced to the mills.

The second period gave much more satisfactory results, as the following figures will show.

Total moneys advanced from 1893 to June, 1907.	Total moneys repaid from 1893 to June, 1907.		Total indebtedness to Treasury (Principal and Interest) June, 1907.
	Principal.	Interest.	
£ s. d.	£ s. d.	£ s. d.	£ s. d.
589,482 14 7	210,326 10 6	193,720 18 7	428,505 2 10

The statement of moneys repaid to the Treasury has been as follows :—

Currency of Period.	Principal repaid and Interest.	Indebtedness to Treasury.
	£ s. d.	£ s. d
I. Period—1893 to December, 1903..	171,178 4 9 ..	580,415 7 7
II. Period—1903 to June, 1907.. ..	232,869 4 4 .	428,505 4 5

An examination of the data contained in the Report furnishes the indication that the largest liquidations during the "period" from December, 1903, to June, 1907, were made by the six mills that were in the possession of the Treasury, and whose management was in the hands of the Comptroller of the Bureau of Central Mills. The following brief table shows in what measure the indication is correct :—

Moneys (Principal and Interest) Paid to the Treasury by the Central Mills during the Period from 31st December, 1903, to 30th June, 1907.

	£	s.	d.
(A) By the seven Companies managing their own affairs	98,016	5	11
(B) By the six Mills under the management of the Comptroller of Central Mills ..	134,852	18	5
Total..	£232,869	4	4

The sums of money paid to the Treasury by the *six mills* (Pleystowe, Proserpine, Gin Gin, Mount Bauple, Moreton, Nerang) that the Treasurer entered into possession of during the two periods that have been defined were as follows:—

Periods.	Under the Management of—	Payments to the Treasury. £	s.	d.
From 1893 to December, 1903..	The Mill Companies ..	29,220	15	3
From December, 1903, to June, 1907.	The Comptroller of Central Mills	134,852	18	5

During the period from December, 1903, to June, 1907, white labour has taken the place completely of coloured labour, which had previously been employed upon given kinds of work. Also during this period the wages of white labour have been increased fully 20 per cent. at the mills which the Treasurer is in possession; and the living conditions of the workmen have been wholly reorganised at a very considerable cost. On another hand, the prices paid for cane during this period have been higher than at any other time in the history of the mills under consideration. All these several considerations, however, must not be allowed to conceal the fact that what has been accomplished at the mills under the control during the period specified has been due in a very notable measure to the favourable seasons that have obtained. Even with the continuance of good climatic conditions, it appears certain that the same high measure of success cannot continue, by reason of fiscal and economic changes that are now transpiring, and which are lessening and must continue to lessen the margin of gain. Should unfavourable climatic conditions recur, then nothing can prevent less favourable and, in fact, serious financial results following. These considerations have emphasized the efforts made, on the one hand, to get the mills put into a thoroughly efficient working condition; and, on another hand, to encourage the placing of more producing settlers upon the land in order to secure an increased supply of cane. The situation, present and prospective, requires the exercise of the most careful device and economy if a measure of the recent success is to be maintained.

SOME NOTES ON THE SUGAR INDUSTRY OF THE HAWAIIAN ISLANDS.

(*From an occasional Correspondent.*)

The Hawaiian Islands, which have of late years become so prominent amongst sugar producing districts owing to their high productiveness, are a group of volcanic islands lying in the North Pacific; the group extends from 18° N. to 22° N. latitude, and 154° W. to 160° W longitude, and thus lies just within the tropics, in this respect resembling Mauritius and Fiji.

Of the eight inhabited islands forming the group, sugar is produced only on Hawaii, Maui, Kauai, and Oahu, the capital and chief business centre of the group, Honolulu, being situated on the last-mentioned island. Of these islands Hawaii is by far the largest, with an area of 4015 square miles and is thus of practically the same size as Jamaica*; Maui, with an area of 728 square miles, is almost identical in area with Mauritius; considerably smaller are Oahu, 598 square miles, and Kauai 547 square miles. All the islands are extremely mountainous (quite half the area of Maui, for example, being occupied by a single extinct volcano), and thus but a comparatively small area is capable of remunerative cultivation; in general, the sugar estates lie in the littoral between the mountains and the sea.

Though by no means so old as is the industry in the West Indian Islands, sugar has formed the staple crop for many years. It is, however, only within the last half generation that it has reached its present proportions; the first impulse towards an increase in production was a reciprocity treaty with the United States, whereby Hawaiian sugar entered free of duty. This was followed by annexation in 1898; actually, however, the present position of the group is not due so much to artificial conditions as to the recognition of the possibilities of irrigation and intensive cultivation. In 1882 the whole crop was 54,000 tons, and the possible output of all available land was estimated to be 84,000 tons. In 1889 attention was turned to the immense supplies of water underlying the islands, and capable of utilization by a system of artesian wells. Since then progress has been rapid, and some of the installations are of immense size. Of particular interest is a recently-installed electrically-operated plant in the island of Kauai; the power required—over 2000 h.p.—is conveyed under high tension a distance of 34 miles. In other instances irrigation water is obtained directly from the natural rainfall, and is conducted from the wet upland areas to the estates by systems of canals, flumes, and syphon pipes. These works are often of considerable magnitude, entailing the damming of valleys, the

* Or twice the size of Lancashire.—[Ed. *I.S.J.*]

cutting of canals in the face of almost vertical cliffs, and the conduction of water in steel piping across mountain gorges. A notice of some of the more recent undertakings will be found in a British Consular Report quoted in this Journal (July, 1907).

The rainfall in these islands varies within wide limits; in parts of Hawaii, where irrigation has only recently been introduced, and where most of the estates are worked under natural conditions, it may reach 200 inches per annum, and on the drier islands of Oahu, Maui, and Kauai may fall to as little as 30 inches.

The acreage annually reaped is at present very close to 100,000 acres, and this is very evenly divided between irrigated and unirrigated plantations, the great majority of the latter being on the island of Hawaii. From this acreage sugar is obtained at the average rate of from four to four and a half tons (of 2000 lbs.) per acre, the average return from plantations operated under natural conditions being from two to three tons, and from those artificially watered five to six tons. At times notices have appeared in the sugar press of enormous yields up to 12 tons per acre obtained in these islands, and although in favoured spots returns of this order have been obtained over areas of considerable magnitude, it must not be supposed that any such returns are general.

The sugar cane is probably indigenous to the islands, but none of the native varieties are grown on the estate scale; by far the greater portion of the cultivated area is devoted to the varieties, Lahaina, Yellow Caledonia, and Rose Bamboo, varieties familiar elsewhere under the names of Bourbon, White Tanna, and White Transparent. Hawaiian experience with the first-mentioned variety is similar to that elsewhere; under favourable conditions it is a heavy cropper, with rich and pure juice, but is susceptible to damage from insects and to disease.

Under the conditions prevailing in these islands, canes not only afford a high tonnage, but give a juice of high saccharine content and purity, so that, combined with high mill extraction, the weight of cane per ton of sugar has reached a very low limit. On an average, very considerably less than ten tons of cane are required to give a ton of sugar, and in special instances over short runs a ton of sugar may be produced from as little as seven tons of cane.

The sugar factories of the islands are notable not only for their size, but also for their equipment. The largest factory in the group, and until recently the largest in the world, is that belonging to the Hawaiian Commercial and Sugar Company, at Puunene, on the island of Maui. This factory was described in detail in the *Proc: Inst: Mech: Eng:* December, 1902,* and in general arrangement is typical of the more recently erected factories. It now produces annually over 40,000 (short) tons of sugar, and there

* An abridged reproduction of this paper appeared in the *I.S.J.* at the time.

are a number of other factories with an annual output of over 20,000 tons. The average production of the 45 factories now in operation is a little under 10,000 tons.

This production per factory may be compared with that in other sugar producing districts. In Java there are about 170 factories with an annual production of approximately 1,000,000 tons, giving an average of about 6000 tons per factory; in Demerara the annual production ranges from 100,000 to 120,000 tons divided between some 40 to 50 factories giving an annual average output of about 2500 tons; Mauritius with an annual production of 200,000 tons or thereabouts had a few years ago some 60 factories working so that there the annual average production per factory would be over 3000 tons.

Practically all the canes grown in the islands are treated by not less than three mills, together with a heavy maceration; and several of the factories employ four mills. A preparatory treatment of the cane by cutters, shredders or crushers is quite general; the machinery employed in the subsequent processes is quite on a par with the general excellence of the milling plant.

In previous years Scotch engineering firms conducted a large business with Hawaii, but owing to annexation and to the greater proximity of America this business has been diverted into other channels; the more recent factories have been largely erected and equipped by the Honolulu Ironworks, and this firm too has lately been responsible for large installations in Formosa.

The population of the group is, at the present moment, estimated at about 218,000, so that the annual production per unit of population is about two tons; this is a very high production compared with other districts where sugar forms the main staple of commerce, and although no strict comparison can be made, such a high production reflects high yields and the development of labour-saving appliances. The scarcity of labour is, however, one of the difficulties with which the Hawaiian producer has to contend; any system of indentured labour is repugnant to the spirit of the American Constitution, and each labourer works entirely as a free agent with full control over his movements. The majority of the labourers on the plantations are Japanese, the balance being made up of Chinese, Koreans, Porto Ricans, Portuguese, and native Hawaiians; more recently some Spaniards have been introduced. The rate of wage is very high as compared with that paid in other countries employing local or imported Asiatic labour, and averages about three shillings per day.

The *personel* of the larger plantations differs in many ways from what obtains in other places. The controlling head of a concern producing upwards of 20,000 tons of sugar is in a very different position to one where the production is only one-tenth of this, and in such a position executive and administrative ability are of larger

value. The manager of such a plantation corresponds more in position to the planting attorney of a group of West Indian estates, and the duties of the manager become divided between the field superintendent and the mill superintendent. The position of a chemist or engineer connected with a number of scattered and perhaps widely separated estates disappears too, and these officials become confined to one factory. The employment of Caucasians in the positions of sugar boilers and bookkeepers—positions often filled in the West Indies by Ethiopians and Asiatics—is very general.

A question that frequently arises for discussion in Demerara is the position of overseers and their inability to marry or enjoy any home life until they may succeed to the position of manager. The barrack system of overseers' quarters is absent from these islands and the position of most of the employés is such that they can, if they think fit, enjoy the privileges of married life.

Absentee proprietorship has often been blamed for the depression in the industries of the West Indies; and to the fact that many of the largest interests of the Hawaiian Islands are controlled by men domiciled in the islands and conversant with every phase of the industry may not unjustly be attributed the high level and general prosperity of most of the undertakings. It requires no argument to demonstrate that the resident proprietor is in a better position to appreciate the conditions of an industry than is the chairman of a distant board of directors, whose visits to the scene of his interests are infrequent and brief.

Planters in Hawaii learnt early the advantage of combination and interchange of ideas. The Hawaiian Sugar Planters' Association is now more than 25 years old, and operates as an active and virile body; it is concerned with all matters relating to the industry from the organization of a labour supply to discussions on matters of technical interest. Controlled by this Association is an Experimental Station comprising three divisions—agriculture and chemistry, plant pathology, and entomology. References to the work of this station and notices of its publications have from time to time appeared in the pages of this Journal; a striking instance of the value of such a station was afforded recently by the successful collection and introduction of parasites of the leaf hopper *Perkinsellia saccharicida*, an insect which in its method of attack resembles the cane fly *Delphax saccharivora* which appeared in the West Indies in the early part of last century. At the present moment an entomologist is ransacking the Orient in a search for parasites of the locally destructive cane borer *Spenophorus obscurus*.

The Acadia Sugar Refining Company has had a satisfactory year, the dividends paid for 1907 being 6 per cent. on the preference shares and 3 per cent on the ordinary shares.

MECHANICAL TILLAGE.

By the Hon. Francis Watts, C.M.G.

During the last two years, a very considerable amount of attention has been directed in Antigua, to questions connected with the more extended use of implements in the cultivation of the soil; this has resulted in some important movements and experiments of some cost and magnitude.

Two firms have imported sets of steam-ploughing appliances from Messrs. Fowler & Co., of Leeds. Although the work was started, in each instance, by experienced ploughmen employed by Messrs. Fowler, some difficulties have been encountered owing to the peculiar conditions.

The advantages expected from steam ploughing are that deeper cultivation is possible, and consequently, the soil has a greater power of absorbing rainfall. Drought will, therefore, be the better able to be resisted, and the land able to be ploughed at the proper period, *i.e.*, when in the best condition as regards moisture. The best cultural results may thereby be obtained, independent of the working animals of the plantation, which are busily engaged in crop time in hauling canes and in other duties, and so are not available for ploughing when, perhaps, it is most desirable that this work should be done.

One set of steam ploughs was introduced on the Belvidere estates. Here, owing to the peculiar character of the soil, coupled with an abnormally heavy fall of rain, the results obtained were far from satisfactory. Mr. A. St. G. Spooner, who has charge of these properties, has given the following notes on the work done:—

"Our land is for the most part a very heavy tenacious clay varying from brown to mouse colour, underlaid at a depth of from 8 to 18 inches by a yellowish clay subsoil of even greater tenacity and impermeability than the top soil. The lands are almost flat, so that great attention has to be paid to drainage. Lands of this kind can really be only effectively broken up when the land is dry (the condition between wet and dry most favourable to their working never exists but for a very short time under tropical conditions). If worked when wet the soil gets 'plastered' and runs together again, and no cultivation of any value can be done. When the soil is dry, it becomes so hard that no manageable team of oxen can plough it more than about eight inches deep, and the work is very severe on the cattle. Twenty cattle and one plough average half acre ploughed per day.

"The land is divided by trenches about 18 to 20 inches deep into beds 15 to 25 feet wide, according to the heaviness of the land, and the cane rows run across these beds, the cane being planted in shallow furrows. The beds are made turtle-backed, so as to run the

water from the cane furrows into the trenches in case of rain falling at a greater rate than the land can absorb it.

"In ploughing with cattle, the land is ploughed along the beds and parallel with the trenches; so that the latter are not interfered with and only require a shallow re-trenching each time the fields are cultivated. If heavy rains fall when the land is being cultivated, the beds being turtle-backed and the trenches open, the water can run off, and so cattle ploughing can generally be done in the wet season after crop.

"With such shallow cultivation as is possible with cattle ploughs, the land suffers severely from drought in a dry season, and as the subsoil is unbroken, undrained, and sour, and consequently not permeated by cane roots to any extent, the root range of the cane is a small one, and the only way of getting good crops lies in the liberal application of pen manure to make the shallow feeding area of the crop as rich in available plant food as possible.

"In wet weather it is impossible to weed this sticky land, and much damage is done to the tilth by the running together of the soil, under the influence of the heavy tropical rains, so that almost as poor a crop is obtained in a wet year as in a very dry one. In order to obtain deeper cultivation with its consequent advantages of a greater power on the part of the soil to absorb the rainfall and to resist drought, it was decided to introduce the use of steam-ploughing machinery, and a set of implements and engines was accordingly obtained from Messrs. Fowler, of Leeds, England, after our lands had been reported on by an expert from this firm. Other results of deeper cultivation would be the better drainage of the top soil, and the provision of a more extensive feeding area for the roots of the canes, thereby rendering the crop less dependent on pen manure, which it is almost impossible to produce in sufficient quantities, and the application of which, as well as the raising, is a matter of great expense. By the use of the more expeditious steam plough, too, it was hoped it would possible to get through the whole of the cultivation in the dry months, when the oxen are employed in cane haulage. This would enable much earlier planting to be done (a most important point on heavy land, where growth is slow, in a not too hot climate like that of Antigua).

"Our experiences have not been fortunate, mainly because we have not had a sufficiently dry season, and also because the implements sent do not suit our conditions. It was not until August that the land was really dry enough for effective work, and then we found that the land could only be ploughed across the beds, and that when an attempt was made to plough along the beds, as with cattle ploughing, this could only be done as long as the plough wheels were both on the beds; as soon as one wheel was down in a trench the plough at once went so deep that the engines could not pull it,

and it turned up large amounts of subsoil. It was, therefore, possible only to plough the middle of the beds, leaving half the land unploughed. Once the plough wheel got into the trench no amount of steering could get it out again with the implements Messrs. Fowler supplied, we had therefore no choice but to plough across the beds, and in doing this we of course ploughed across the trenches and filled them up. The work also had to be done very slowly for fear of breaking rope or plough. Thus, only about four acres a day could be done—about one-third of the amount of work that Messrs. Fowler's expert told us the ploughs would do. After these drains were filled up the land was subsoiled twice, at right angles, to a depth of about two feet. The land so broken up looked very satisfactory, but this state of affairs did not last long. Heavy rains fell almost immediately after, and there being no possible means for the water to escape, the land simply filled up with water, and became for some time a bog, over which walking was impossible. The water lay in pools all over the surface, and the effect of the elaborate cultivation was practically all lost. We started and reclaimed this land by digging trenches 50 feet apart and three feet deep through it, with clay spoons at a cost of nearly seven times that of re-trenching cattle-ploughed land. Even after this, it was some time before we could attempt any further operations, and by this time the land was a dense field of Para grass. After the costly elimination of this, the only thing to be done was to 'bank' the land by manual labour, as the implement supplied by Messrs. Fowler was useless for its work even in the hands of the ploughman whom they sent out. In digging these trenches there was not the least evidence of the land having been twice subsoiled; it had simply set back to its original condition.

"Unless, therefore, land can be effectively drained down to the bottom of the subsoiling, say, two feet deep, immediately after the cultivation has been done, and before heavy rains fall, the whole value of the steam cultivation will be nil. The steam ploughman in charge of the plant seemed very doubtful whether any implement made by Messrs. Fowler could be made to take out trenches of this kind in such heavy land.

"Messrs. Fowler sent out an implement called a 'mole drainer' to underdrain the land about 2-2½ feet deep. I shall say nothing of this implement, as we cannot claim to have tried it fairly. It is claimed that in a clay subsoil it will make a permanent drain, and that open drains may be dispensed with. I have grave doubts whether it will prove of any use under our conditions. Steam ploughs have many things against them, and they are practically useless unless the land is very dry. Under certain conditions, they will do excellent work; but if they are not to be a constant source of anxiety, they must be handled by expert, intelligent and highly paid men who have been used to them for many years. They are most difficult things to

work, except in very dry weather, and the delays from breakages, when spares may have to be sent out from home, make it very risky to rely on them entirely. They will not plough land covered with fresh trash, but will plough this land after the trash has lain on it for about six months and become brittle and rotten. Until the difficulties of draining land subsoiled by them have been overcome, it is useless to subsoil, and if subsoiling is not done they have little or no advantage over ploughing by oxen, and are very much more expensive. Their right place would seem to be where large areas of land that do not require drainage have to be dealt with."

Better results have been obtained with the other set of ploughs introduced on the estates of Messrs. Du Buisson & Co. Here the soil is lighter and better drained than at Belvidere, but even here difficulties were experienced. Those in charge of the appliances suggest that many modifications are desirable in order to enable the implements to do good work. I am not in a position to discuss these suggested modifications in detail. They lie, however, in the general direction of the use of broader tires on the wheels of several of the implements, in order to obviate the tendency to sink in soft soils; in the strengthening of several parts; the raising of the height of some of the frames; the modification of some of the steering-gear, and many similar points, doubtless of significance. Although Messrs. Fowler sent expert ploughmen to start the work, and these men did a considerable amount of ploughing, still it may be suggested that some of the difficulties may arise from the inexperience of some of the other workmen employed. This, however, will not account for all the difficulties.

Under these circumstances, it seems possible that much time may be lost in correcting the difficulties owing to the fact that the makers and designers are at a distance from the places where the implements are used and are unable to form a correct appreciation of the problems involved. Much more rapid progress, and probably some considerable business developments, would appear to be possible if the makers of the appliances could see their way to send out a skilled representative who would spend his time in visiting the various West India colonies, and observing the machines in operation.

Despite these difficulties, which I have emphasized in the hope that it may be possible to remedy them, there is reason to believe that steam ploughing and cultivating will be successful, and will solve many of the problems at present met in the working of the sugar estates. Deeper and more thorough cultivation at those times when the soil is in the best condition for treatment, the breaking of the subsoil as well as improved surface tillage should do much to increase crops. In countries of deficient rainfall much benefit may be expected to result from such a breaking up of the subsoil as would enable it to

store up, and hold in reserve, that part of the rainfall which is not immediately required.

It has not been found possible to do satisfactory work with steam ploughs when the trash from the sugar cane lies on the soil; this has therefore to be removed. Neither has it been found easy to apply pen manure in connection with steam ploughing; it is difficult to turn in the pen manure in the process of ploughing; it is also difficult to get on the land in order to apply it after ploughing. An interchange of experiences of work in this connection would doubtless be profitable.—(*West Indian Bulletin.*)

BREEDING HYBRID SUGAR CANES.*

By F. A. Stockdale, B.A. (Cantab),

Mycologist and Agricultural Lecturer on the Staff of the Imperial Department of Agriculture for the West Indies.

Experiments in the raising of seedling sugar canes by hybridization under control were commenced at Barbados in 1904. The flowers of one variety were emasculated while young, covered in a muslin bag, and then pollen from another variety was transferred to them. As the result of this work five stools of hybrid canes of known parentage were obtained and were under investigation during last season. One of these stools suffered very severely during the drought, but two cuttings were obtained from it. At the present time there are 166 plants growing from the five hybrids obtained, and laboratory tests will be made later to ascertain the saccharose content of their juices. Four pedigree hybrid sugar canes have also been raised in Queensland, and it is reported that during 1905-6, owing to a favourable season, over 600 hybrids were obtained at the Harvard Experiment Station, Cuba.

In a paper by Sir Daniel Morris, K.C.M.G., and myself, that was communicated to the International Conference on Genetics, held under the auspices of the Royal Horticultural Society during July and August, 1906, a concise account was given of the different methods by which improved varieties of sugar cane had been obtained by selection and hybridization. Some of the results obtained by those working in this direction were given, together with the individual advances made by some of the more important cane-growing countries. It was pointed out that attempts to procure an improved race of sugar canes centred around breeding from the best varieties, but it was suggested that in the future the best results were likely to be obtained by first carefully analysing the different characteristics of the different varieties under cultivation, in the hope

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* A paper read at the *West Indian Agricultural Conference, 1907.*

that it might be possible to pick out desirable qualities from one variety and combine them with other desirable qualities of another variety. The necessity of adopting a method of breeding for definite objects has been brought conspicuously to the front by the fact that it has repeatedly been pointed out that the breeding ability of the various mother plants varies considerably. Frequently a variety which is low down in the list in respect to saccharose yield per acre gives seedlings that are of much more value than a similar race of seedlings produced from a cane that is much higher in the list, or, in other words, a cane of comparatively low value often gives a much greater percentage of subsequently selected seedlings than a cane which in itself is of a much higher value. In the one case we have what has been described as a strong "projected efficiency," and in the other a weak "projected efficiency." This variability noticed amongst the offspring has led to considerable confusion, for the plant has been considered as a whole; when each separate character, if taken alone, may be found to obey definite simple laws. Single characters must be treated as distinct, and the composition of individual plants must be considered as much by their progeny as by their ancestry.

In raising new varieties by selection, advantage is taken of the fact that plants raised from seed are never exactly like the parent, while hybridization is often held by some to awaken the sum total of variation in the two parents, with the result that the seedlings thus obtained present many variations. The raising of new and improved races of plants depends upon this circumstance of variability, and it would appear that the differences between separate members of one family are of two kinds: (*a*) individual differences, usually quantitative, between the various members, such as differences in size of plants or in size of any particular part of a plant—for example, a fruit; and (*b*) definite or qualitative differences, existing between different strains of plants. It is from these definite differences, by a process of hybridization, that new varieties of plants of increased value can be raised.

It has been shown that hybridization of the sugar cane under control can successfully be carried out. Therefore, instead of depending on raising seedlings by planting arrows from the better varieties, by which only the seed-bearing parent is known with certainty, and instead of making a considerable number of crosses indiscriminately with the hope of obtaining some improvements, hybridization experiments on definite lines have been laid out, in which the different useful characteristics of the several varieties are carefully considered. By this means the possibility of an individual deviating to a marked degree toward a desired type becoming pollinated with pollen from less desirable varieties is eliminated, and by the careful selection of the varieties to be experimented with there

is little chance of a reduction of the standard of perfection already attained.

During recent years it has been conclusively shown that a general knowledge of the characteristics of different varieties is of the utmost importance, as by such knowledge it is often possible to confine the work to a small number of varieties possessing those desired qualities which are not to be found in other sorts. The physiology of heredity—the manner in which different useful characteristics are handed over from parents to offspring—is becoming more fully understood, and has lately been the subject of exact scientific inquiry. The results so far obtained tend to show the value of the technical methods that have been developed by the experience of practical men.

Kobus, in Java, in reports issued between the years 1898 and 1901 on the crossing of Java canes, as seed-bearing parents, by natural hybridization with the East Indian variety Chunnee, as pollen-bearing parent, states that "in some cases the fecundating power of the Chunnee variety is so strong that more than 95 per cent. of the hybrids resemble the male parent," and Professor Harrison, in a report on the Agricultural Work in the Botanic Gardens and the Government Laboratory, British Guiana, for the years 1896-1901, states that it was being found that "while the seedlings of the older varieties with but few exceptions show marked tendency to variation, the seeds of canes from seedling canes do not possess this property to anything like the same extent, and in many of these the offspring appears to come fairly true to parentage." Such records as these on the raising of seedling canes show that some varieties possess characteristics that are transmitted to their offspring, while others do not.

In reference to many other plants it has repeatedly been noticed that when two varieties, which differ by definite characters, were crossed together, the offspring of such a cross partakes to some extent of the different characteristics of either parent, and frequently all to an equal extent. It was further found that if these offsprings were crossed amongst themselves or allowed to self-fertilize, a large number of forms arose in the next or second generation. This was not fully understood until 1901 when the discovery of experimental work carried out by Mendel gave an explanation of the hereditary processes with which the breeder is concerned.

Mendel's Work on Inheritance in Peas.

Mendel experimented with the crossing of a large number of peas and centred his attention not on the plant as a whole, but upon its simplest characters, such as shape of seed, colour of flowers, length of stem, &c., and traced in detail the behaviour of each character in the hybrids, keeping the records of these simple characters, singly, separate from all others; for he held that "in order to discover the

relations in which the hybrid forms stand towards each other and also towards their progenitors, it appears to be necessary that all members of the series developed in each successive generation should be, without exception, subjected to observation."

The exact nature of Mendel's work may possibly be made clear by taking one or two examples from it.

Two varieties of peas were chosen, one of which possessed smooth, round or roundish seeds, while the other possessed seeds that were irregularly angular or deeply wrinkled. These were cross-fertilized. The plants arising from this cross possessed round seeds entirely, of such a form that differences could not be detected between them and the round seeds from one of the parents. It appeared, therefore, that a character of one parent was transmitted complete or almost complete in hybridization to the exclusion of the corresponding character of the other parent. This constituted the character of the hybrids of the first generation, which may be designated by the sign (F. 1). The character which is transmitted is said to be *dominant* to that which is excluded, and the latter may be called *recessive*—roundish form of seeds *dominant* to the wrinkled or angular form.

Now, if plants of the first generation (F. 1) were allowed to self-fertilize themselves and a further generation (F. 2) raised from the seed they produced, the recessive character—the angular form of the seed—appeared. Twenty-five per cent. of the seeds in this second generation (F. 2) were angular, while 75 per cent. were round or roundish—or a proportion of 3 dominants to 1 recessive.

In the third generation (F. 3), the offspring from the angular seeds of (F. 2) bore nothing but angular seeds, thus showing that the recessive character was constant; while in the offspring from the roundish seeds of (F. 2), which are all so much alike as far as external appearances go, it was noticed that twenty-five out of seventy-five (*i.e.*, 1 out of 3) produced the round character purely, whilst fifty produced both round and angular seeds in the proportion of 3 of the former to 1 of the latter, *i.e.*, 3 dominants to 1 recessive. From this it was seen that some of the round seeds of the second generation (F. 2) bred true to round, while others did not. The former were therefore "pure" round and the latter "impure" or "hybrid" round. It was proved that the "pure" rounds through many generations kept true, and showed no reappearance of the angular recessive character. The "hybrid" rounds, however, produced pure round, hybrid round, and pure angular, just as their parents did.

It was moreover seen that 100 plants from the progeny of the hybrid of (F. 2) consisted of twenty-five pure recessive, twenty-five pure dominant, and fifty similar in constitution to the hybrid form, since they gave offspring of the same character in the same proportions.

This can be shown diagramatically as follows:—

Round × Angular (or *vice versa*).

F. 1. all round.

F. 2. 3 round. 1 angular.

F. 3. 1 pure round. 2 impure round. 1 angular. angular.

F. 4. pure round. 1 pure round. 2 impure round. 1 angular. angular. angular.

In further generations a similar result was obtained and other characters were found to behave in a like manner. In peas it was found that tallness is dominant to the dwarf habit, the round shape of the seeds dominant to the angular form, &c.

The exact results may be given in the abbreviated form—D. being written for the dominant character and R. for the recessive—and is applicable for any pair of similar characters:—

D. crossed with R.

F. 1. DR. (hybrid, in appearance D.)

F. 2. D. 2 DR. (in appearance D.) R.

F. 3. D. D. 2 DR. R. R.

F. 4. D. D. D. 2 DR. R. R. R

Experiments subsequently conducted by Bateson, Saunders and others for the Evolution Committee of the Royal Society, and by Biffen and others on wheat breeding have given similar results. It is, therefore, concluded that the *gametes*—the male and the female germs-cells—are pure with respect to the characters they carry, and assuming that an approximately equal number of pollen grains and egg-cells carry either one or other of the characters, the numerical relations observable in the progeny of the hybrids find a simple explanation; for according to the law of probability, when self-fertilization occurs in a DR. form, if the gametes bear either one of the characters in approximately equal numbers, the chances are that

a D. pollen grain may meet with a D. or R. egg-cell, giving rise to a form either with dominant characters alone or to a hybrid, *i.e.*, a D. or a DR.; while an R. pollen grain may meet with an R. or a D. egg-cell and give rise to R. or DR. forms. No other combinations are possible, and, therefore, the progeny would be represented by a series of individuals of the following forms:—D. + 2 DR. + R.

The D. and R. forms breed true, as their gametes carry only dominant or only recessive characters, whilst the DR. forms produce on self-fertilization the D. + 2 DR. + R. series again.

We have considered, as yet, only varieties different in simple characters; but varieties differing in two or three pairs of characters have been experimented with, and it has been found that the gametes carry each of these characters pure.

If a plant having seeds round and yellow were crossed with a variety having seeds angular and green, definite results would be obtained. We may indicate roundness of seeds by A. and the angular character by a., as roundness is dominant to the angular form, and yellowness by B. and greenness by b., as the yellow character is dominant to the green one. We may consider the first character (shape of seed) and get in F. 2, $A + 2Aa + a$, while if we consider the second character (colour of seed) we get in F. 2, $B + 2Bb + b$. Now, the total number of combinations that the gametes can make will be obtained by multiplying together $(A + 2Aa + a)$ and $(B + 2Bb + b)$; the result of which is $AB + Ab + aB + ab + 2ABb + 2AaB + 2Aab + 2aBb + 4AaBb$.

There are, therefore, nine types possible, but externally they appear as four, namely, round yellow, round green, angular yellow, and angular green, in the proportion of 9 : 3 : 3 : 1; as AB, $2a$B, 2ABb, and 4AaBb have the appearance AB = 9; Ab and 2Aab are of the appearance Ab = 3; aB and $2a$Bb are of the appearance Ab = 3; and ab = 1.

Mendel next tested the truth of his hypothesis that both male and female cells were pure by crossing the first cross hybrid with pure dominant and pure recessive forms respectively. It was found that DR. crossed with D. gave DD : DR as 1 : 1, and that DR. crossed with R. gave DR : RR as 1 : 1.

(*To be continued.*)

A large sugar factory at Kharkoff, belonging to Messrs. Charitonenko, was burnt down last month, resulting in 1800 persons being thrown out of work.

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. Thompson, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; and 322, High Holborn, London.

ENGLISH.—Applications.

24503. B. Hafner and F. Krist, London. *Improved manufacture of fermentable sugar from materials containing starch or cellulose.* 5th November, 1907.

24623. J. J. Eastick, London. *Process for removing alkaline salts from saccharine and other products.* 7th November, 1907.

25851. H. W. Aitken, Glasgow. *Improved preparatory breaking rolls for sugar-cane mills.* 22nd November, 1907.

26109. R. Harvey, Glasgow. *Improvemements in and relating to apparatus for heating sugar-juice and other liquids.* 26th November, 1907.

GERMAN.—Abridgments.

188043. Cornelius Dalzell Ehret, of Ardmore, U.S.A. *A centrifugal having a drum directly connected with the armature of an electric motor.* 14th March, 1905. The characteristic feature in this centrifugal is that the electric motor is arranged in the central space of the drum which is made annular.

188690. Fritz Scheibler, of Aix-la-Chapelle. *An apparatus for simultaneously charging the sugar cubes coming from a slicing machine into several packets.* 3rd April, 1906. The sugar cubes coming from a slicing machine are, in this apparatus, simultaneously filled into several packets with the assistance of interconnected sheet metal boxes in which the sugar is previously arranged in rows, and the characteristic features are that the sheet metal boxes are so arranged on an angle point, pivotal through 90°, of a roof-shaped frame, in such a way that in the first position the packets are easily drawn over the sheet metal boxes, and in the second position may be simultaneously filled with the contents of the boxes by their upward withdrawal.

188691. Fritz Scheibler, of Aix-la-Chapelle. *Apparatus for simultaneously filling the sugar cubes coming from the slicing machine into several packets.* 15th September, 1906. (Patent of addition to Patent No. 188690, of April 3rd, 1906.) This is an improvement on the apparatus previously described and consists in the sealing or closing of the open ends of the packets taking place on the metal boxes by means of tablets firmly connected with a removable plate and standing at right angles thereto, so that when the metal boxes are transferred to the tilting device the removable plate carrying the tablets is carried with them.

189194. Franz Schipper, of Brünn, Moravia. *Apparatus for cutting off the bottom of sugar loaves.* 27th October, 1906. This apparatus is characterized by a drum being mounted in a cylindrical frame adapted to be brought against the sugar loaf by means of a screw spindle, the bottom of which drum is provided with radial slots and beneath these knives are provided, so that on the rotation of the screw spindle the drum is moved against the bottom of the sugar loaf and this latter is cut smooth by the knives.

189624. Franz Hampl, of Elbe-Teinitz, Bohemia. *A centrifugal drum for sugar loaves having moulds arranged radially or tangentially in two or more rows one above the other.* 7th September, 1906. This centrifugal for sugar loaves is characterized by the drum being composed of separate mould sheaths, which are put together in several superimposed series of rings arranged one above the other between flat rings engaging with them or enclosing them, and tightened up by means of anchoring screw bolts, so that the flanges of the mould sheaths form in a known manner internally a tightly closed cylindrical casing which merges into a large number of conical sheaths for receiving sugar moulds.

190613. Dr. Max Melcher, of Uerdingen-on-Rhine. *A process for producing large threadless crystals of good appearance, more particularly of sugar candy, from cold or hot saturated solutions.* 22nd August, 1906. By this process crystals of good appearance are produced by periodically moving the forming crystals during the crystallization, and the arrangement for doing this comprises a series of horizontal sieves provided with mother crystals and arranged one above the other in a crystallizing vat, which may be provided in the ordinary way with a cooling jacket, such sieves being moved up and down in the feeding liquid, in such a way that the crystals are held for a period in the solution in a floating condition.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of November, 1906 and 1907.

IMPORTS.

Raw Sugars.	Quantities. 1906. Cwts.	Quantities. 1907. Cwts.	Values. 1906. £	Values. 1907. £
Germany	7,863,979	7,107,062	3,432,144	3,415,995
Holland	515,276	572,286	242,047	291,605
Belgium	1,223,096	516,850	555,452	245,099
France	248,462	436,631	109,435	226,245
Austria-Hungary	189,817	333,587	77,507	152,093
Java	305,225	1,072,096	146,522	565,083
Philippine Islands	....	230,364	....	96,287
Cuba	111,885	91,113	41,943	39,610
Peru	524,290	489,573	237,025	240,731
Brazil	976,098	191,376	382,849	79,005
Argentine Republic	....	....	....	....
Mauritius	126,741	529,531	48,362	218,913
British East Indies	146,713	117,489	60,570	50,509
Straits Settlements	92,648	195,165	36,959	80,396
Br. W. Indies, Guiana, &c.	1,534,604	1,174,084	818,211	679,925
Other Countries	189,909	526,097	88,221	259,454
Total Raw Sugars	14,048,743	13,583,304	6,277,247	6,640,860
Refined Sugars.				
Germany	11,048,970	11,813,184	6,321,082	7,005,274
Holland	2,572,507	2,380,468	1,560,978	1,516,859
Belgium	507,074	532,307	298,052	321,790
France	2,213,919	3,157,071	1,255,871	1,855,552
Other Countries	3,855	2,756	2,251	1,940
Total Refined Sugars	16,346,325	17,885,786	9,438,234	10,701,415
Molasses	2,534,845	2,689,893	489,846	526,199
Total Imports	32,929,913	34,158,983	16,205,327	17,868,474

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	263	292	175	220
Norway	16,731	13,575	9,961	8,186
Denmark	90,153	86,457	45,513	47,645
Holland	73,965	63,720	45,588	43,111
Belgium	10,245	9,054	5,984	5,583
Portugal, Azores, &c.	28,556	15,721	15,586	8,922
Italy	32,584	24,549	16,472	13,556
Other Countries	601,133	434,950	393,537	323,739
	853,630	648,318	532,816	450,962
Foreign & Colonial Sugars				
Refined and Candy	32,120	31,829	20,288	21,485
Unrefined	158,659	67,834	81,190	40,250
Molasses	5,548	4,233	1,784	1,282
Total Exports	1,049,957	752,214	636,078	513,979

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1907. Tons.		1906. Tons.
Total Receipts Jan. 1st to December 19th.	1,901,381	..	1,894,176
Receipts of Refined ,, ,, ...	730	..	1,905
Deliveries ,, ,, ...	1,895,761	..	1,952,637
Consumption (4 Ports, Exports deducted) since January 1st..	1,887,850	..	1,940,460
Importers' Stocks, December 18th ..	5,620	..	....
Total Stocks, December 31st	116,000	..	135,440
Stocks in Cuba, ,, ...	13,000	..	31,000
	1906.		1905.
Total Consumption for twelve months..	2,864,013	..	2,632,216

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1906 AND 1907.

(Tons of 2,240lbs.)	1906. Tons.		1907. Tons.
Exports	1,110,685	..	1,316,309
Stocks	36,429	..	63,045
	1,147,114	..	1,379,354
Local Consumption (nine months)	32,570	..	34,980
	1,179,684	..	1,414,334
Stock on 1st January (old crop)	19,450	..	——
Receipts at Ports to 30th September ..	1,160,234	..	1,414,334

Havana, September 30th, 1907. J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR ELEVEN MONTHS ENDING NOVEMBER 30TH, 1907.

SUGAR.	Imports. 1905. Tons.	1906. Tons.	1907. Tons.	Exports (Foreign). 1905. Tons.	1906. Tons.	1907. Tons.
Refined	659,416	817,316	894,289	1,121	1,606	1,591
Raw	653,465	702,437	679,165	4,781	7,933	3,392
Molasses	119,339	126,742	134,494	138	277	212
Total	1,432,220	1,646,495	1,707,948	6,040	9,816	5,195

	Home Consumption. 1905. Tons.	1906. Tons.	1907. Tons.
Refined	660,098	796,349	879,746
Refined (in Bond) in the United Kingdom	512,337	499,681	463,911
Raw	94,211	109,558	110,689
Molasses	111,890	121,898	122,643
Molasses, manufactured (in Bond) in U.K.	51,758	57,004	56,957
Total	1,430,294	1,584,490	1,633,946
Less Exports of British Refined	28,765	42,681	32,416
Total Home Consumption of Sugar	1,401,529	1,541,809	1,601,530

STOCKS OF SUGAR IN EUROPE AT UNEVEN DATES, DEC. 1ST TO 24TH, COMPARED WITH PREVIOUS YEARS.

IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	TOTAL 1907.
143	1210	616	860	215	3045

	1906.	1905.	1904.	1903.
Totals	3057 ..	3106 ..	2721 ..	3295

TWELVE MONTHS' CONSUMPTION OF SUGAR IN EUROPE FOR THREE YEARS, ENDING NOVEMBER 30TH, IN THOUSANDS OF TONS.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria-Hungary	Holland, Belgium, &c.	Total 1906-07.	Total 1905-06.	Total 1904-05.
1886	1157	653	532	199	4428	4441	3755

ESTIMATED CROP OF BEETROOT SUGAR ON THE CONTINENT OF EUROPE FOR THE CURRENT CAMPAIGN, COMPARED WITH THE ACTUAL CROP OF THE THREE PREVIOUS CAMPAIGNS.

(From Licht's Monthly Circular.)

	1907-1908. Tons.	1906-1907. Tons.	1905-1906. Tons.	1904-1905. Tons.
Germany	2,135,000 ..	2,238,000 ..	2,415,136 ..	1,598,164
Austria	1,460,000 ..	1,344,000 ..	1,509,870 ..	889,373
France	725,000 ..	756,000 ..	1,089,684 ..	622,422
Russia	1,410,000 ..	1,470,000 ..	968,000 ..	953,626
Belgium	235,000 ..	283,000 ..	328,770 ..	176,466
Holland	175,000 ..	181,000 ..	207,189 ..	136,55
Other Countries .	435,000 ..	445,000 ..	415,000 ..	332,098
	6,575,000	6,717,000	6,933,649	4,708,758

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The Editor will be glad to consider any MSS. sent to him for insertion in this Journal and will endeavour to return the same if unsuitable; but he cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTICE TO READERS.—If the Advertisement pages stick together, bang their edges on the table, when they should easily separate.

NOTES AND COMMENTS.

The Sugar Convention and its Detractors.

The Radical press has been making the most of adverse reports that have come from Liège regarding the beet sugar industry in that district, where the beet crop is stated to be decidedly short and the percentage of sugar to be much below the average. And furthermore the statement that the effects of the Brussels Convention have not so far been as favourable to the industry as was anticipated, is eagerly quoted as another nail to drive into the coffin of the hated Convention. We fail to see however what an occasional failure of crops here and there, owing largely to climatic conditions (over which the Convention does not profess to have any control), has got do with the merits of this measure. There are bound to be a number of districts in each campaign which have not had the most satisfactory year, but unless they are exceptionally numerous their effect on prices will be very small. And was it not one of the objects of the Convention to so extend the world's area of sugar growing (both beet and cane) that the failure of a crop in one particular district or even country should not have any far-reaching effect on the world's supplies and hence on the world's prices? So that the existence of the Convention ought to be some security against that undesirable fluctuation in prices, if it is only given enough time to fulfil its object.

Apart from this, it must not be overlooked that the reasons which here and there actuate discontent with the Convention in Continental circles are as a rule the very opposite of those holding in this country. Here in the United Kingdom the principal agitators against the Convention are the sugar users whose pockets are affected and the soi-disant champion of the consumer, generally some politician who has an axe of his own to grind. But abroad it is not the consumer who is chiefly considered, it is the interests of the sugar growers and manufacturers; and if these parties are discontented it is mainly because prices are not high enough to ensure them the large profits which they made in most of the campaigns previous to the signing of the Convention.

Our own agitators are repeatedly harping on the subject of the low prices which ruled during the 1901-02 campaign. They will not consider any such thing as average prices, and they tacitly ignore the reasons which brought down the price to the exceptionally low level of that year; in short, they are deaf to all reason, their stock argument is as it were: "Tell us, could sugar be bought at 6s. 6d. before the Convention, yes or no?" One is reminded of the boy in the well-known poem who, warned of the consequences of proceeding, simply reiterated one unintelligible word, "Excelsior." We wonder however if it is realized that those very low prices in 1901-02 have probably had a good deal to do in inducing the Continental Powers to proceed with the Convention in the face of the obstacles which England has in some respects placed in the way. It is certainly difficult at times to understand the great patience shown by these Powers in the course of their negotiations at Brussels when not once or twice England has tried to secure special privileges to which she is barely entitled. It is clear however that the Continental Governments are convinced of the desirability of maintaining the Convention if possible. As to the sugar growers and manufacturers, they will always endeavour to get the best terms for themselves, and it must be confessed their petitions to their own Governments are not always dictated by the wisest of motives; thus we find the French sugar manufacturers are expressing the wish for a system of bounties on the production of denatured sugar for cattle feeding. It is hardly the time, we should have thought, to bring such a request to the notice of their Government.

Chambers of Commerce and the Sugar Convention.

It is only to be expected that the Chambers of Commerce in this country should from time to time express their opinions on international questions and send petitions to the Government on the subject. It must be confessed however that with regard to the question of the Brussels Sugar Convention the decisions of some of these Chambers reveal a depth of bias and one-sidedness that one hardly looks for in a body which is supposed to be truly and fairly

representative of the whole community of traders. We can understand a small Chamber like that of Greenock vigorously supporting the Convention, for sugar refining is one of the staple industries of that town, if not actually the most important one. But when we turn to one of the principal business centres in the Kingdom, to wit Manchester, which deals with all sorts and conditions of trade, we expect a more impartial and less self-interested expression of opinion on the part of its Chamber of Commerce. We must therefore protest against the Memorial which was addresed by the Directors of this Chamber to the Prime Minister last December urging His Majesty's Government to withdraw unconditionally from the Sugar Convention. The reasons given are, in a few words, the interests of "the sugar-using industry and the consumer alike." But as we know the Sugar Convention was formulated in the interests of the consumer since it proposed to ensure him a more even supply of sugar at a natural market price, it is pertinent to consider on whose advice the Directors of the Chamber came to the contrary conclusion. The memorial tells us that it was the *Sugar Section* which was responsible for this remarkable opinion. Here the cat is out of the bag and the real nature of this impartial pronouncement of one of the most important Chambers of Commerce in the Empire stands revealed. For we know that this *Sugar Section* consists entirely of sugar users and dealers, and has as its chairman a manufacturing confectioner who has all along shown the most persistent hostility to all the proceedings at Brussels which culminated in the present Sugar Convention. It is therefore not surprising that they should have considered their own interests as paramount; but that they should have made the Chamber itself their mouthpiece to further these interests strikes us as a very questionable proceeding. One expects a *Sugar Section* to represent all classes of the sugar industry and not one or two particular branches; as at present constituted it would be more accurately described as the "Sugar Users' Section."

Having regard to these facts, we trust that the Government, which seems to be making some real attempt to deal with the problem, will appraise the Manchester appeal at its true value and will only consider it as the opinion of a small and interested section of a great trading community.

Eliminating the Citric Acid from the Soil Solution.

The method usually employed for the analysis of the so-called "available" phosphoric acid and potash is to treat a given quantity of soil with a citric acid solution prepared by dissolving a certain quantity of citric acid in water and making the solution up to a certain volume, say, 1 litre, then mixing a definite weight of the soil and solution in a flask, allowing it to stand for a given time with occasional shakings. At the end of this time, the solution is filtered

off and a definite portion (usually 750 cc.) is evaporated down, treated with HCl and HNO_3, re-evaporated and re-treated with the acids until all the citric acid present in the solution has been eliminated.

The elimination of the citric acid in this way is a rather long and unsatisfactory process, and the following provisional method for simplifying the procedure has been found satisfactory in the Station Laboratory of the Lima Sugar Experiment Station, Peru. To the 750cc. of the filtered solution which contains iron, potash, lime, &c., add a few drops (2 or 3 cc.) of HNO_3; evaporate to a volume of of about 100cc. Transfer the evaporated solution to a 200 cc. Kjeldahl digestion flask used for the nitrogen determination, and continue the evaporation in this flask until the solution is reduced to 50 or 75 cc. Add 30 or 40 cc. of strong HNO_3, continue the boiling and evaporating until reddish fumes are given off and then boil five or ten minutes longer. Remove the flask, transfer the contents to a small evaporating dish, add a littte HCl (3 or 4 cc.), evaporate to dryness. If the operation is carefully conducted there will be no citric acid remaining. The work from this point is continued in the regular manner.

The Abbe Refractometer.

In this number of the *International Sugar Journal* appears a long contribution from the pen of Mr. Prinsen Geerligs on a subject which is just now attracting no little attention amongst chemists, the use of the Abbe Refractometer for the determination of dry substance in cane juices in preference to the older methods which depend for their success on the reading of a Brix hydrometer. Mr. Hugh Main was the first one to draw our readers' attention to the advantages of the new method, and he has been quickly followed by Mr. Prinsen Geerligs who fully confirms all Mr. Main's conclusions, at the same time giving full details of the experiments he undertook to settle the point. Next month we shall hope to give some account of similar experiments undertaken by Professor von Lippmann on beet juices. As he also draws the same favourable conclusion, we have here three expert chemists, who are well known all over the sugar world, advocating the use of a refractometer in the sugar house laboratory.

H. C. Prinsen Geerligs.

Mr. Geerligs, whose connection with the Java sugar industry is about to terminate, has been the recipient of well-deserved honours at the hands of the Syndicate of Java Sugar Planters who have presented him with gold, silver and bronze medals in virtue of his distinguished services as director of their experiment stations. Since 1891, when he landed in Java, that sugar country has made vast strides in the art and science of sugar production, and not a little of its success has been due to the assiduous care and skill bestowed by Mr. Geerligs on

all the work incidental to the experiment station. His well-known book "On Cane Sugar and the Process of its Manufacture in Java" has met with great success and has become a standard work; it will therefore be of interest to our readers to learn that it is shortly to be rewritten and enlarged, and will contain many fresh features detailing all the new scientific processes which have come into vogue since the old work was compiled.

Second International Sugar Congress.

We are asked to state that the Second International Sugar Congress will meet at Paris in March next and visitors will be welcomed, admission being free. A complete report of the proceedings will be prepared in due course, and subscriptions for the same are now invited. The cost will be five francs if ordered before the Congress, otherwise the charge will be ten francs. Application should be made at once to the Secrétaire Général de l'Association des Chimistes, 156, Boulevarde Magenta, Paris.

Mechanical Cane Cutters.

There is no doubt that one of the most needed appliances in the cane sugar industry is an efficient mechanical cane-cutter which shall supersede hand labour without entailing any fresh disadvantages; but it is also clear that we are little nearer a solution of the problem than we were ten years ago. Rumours of success are continually cropping up, generally in a remote quarter of the world, and one has to wait wearily for further particulars. These latter are as a rule never forthcoming, and our readers would do well to accept with all reserve any such claims made by ambitious inventors, until they have been substantiated by confirmatory evidence at the hands of independent and trustworthy witnesses. As a typical instance of what must be often the case, we may mention what occurred on an estate in a certain tropical island noted for its skill in sugar production. The proprietors were at a loss to get the necessary workmen for cutting the canes, and thereupon some half crazy overseer wrote to the papers to say that he had invented a cane-cutter that would almost dispense with the need of attendants. This statement was passed on into the world's press, and led to some anxious enquiries. It turned out, however, that the man had got no further than a rough sketch of his machine, and there the whole invention rested. As any one knows, only prolonged experiment can show whether a cane-cutting invention is of any more than paper value, and we fear that even though it has in some instances got as far as the testing stage, it has as yet never succeeded in securing more than a temporary success.

Confectionery Exports and Imports, 1907.

The West India Committee's *Circular* calls attention to the statistics in the annual trade review of the *London Chamber of Commerce Journal* where it is shown that for the eleven months ended November 30th, 1905, 1906 and 1907, the exports of confectionery, jams and preserved fruits were as follows :—

	Cwts.	£
1905..	315,478	824,221
1906	391,494	952,953
1907..	398,232	1,000,460

The imports of confectionery (including chocolate confectionery) for the same periods were :—

	1905.	1906.	1907.
Imports	74,629 cwts.	.. 67,606 cwts.	.. 59,131 cwts.
Entered for home consumption	72,222 ,,	.. 67,993 ,,	.. 58,433 ,,
Value of imports	£237,753	.. £268,117	.. £147,316

In spite of these figures, the *Journal* goes on to say, last year was not a satisfactory one either for the manufacturing confectioner or the jam-maker. Owing to the enhanced cost of almost every article, *except sugar* (the italics are our own), used in the confectionery trade, viz., boxes, paper, string, coals, &c., manufacturers have not only been working at diminished profit, but in many cases at a loss. The abnormal advance in the price of cocoa has also proved a serious blow to this trade. In conclusion, it may be said that signs are not wanting that in 1908 we shall see falling prices in almost all materials except sugar, which is still cheap and scarcely likely to become cheaper.

A very fine cane grinding plant has just been completed by Messrs. Fawcett, Preston & Co., Ltd., of Liverpool, for Argentina. The rolls of the mill are 34 in. in diameter by 72 in. long and are driven by a horizontal Corliss Frame engine. The gear wheels are of cast steel and made in halves, and the fly-wheel is of very solid construction. Patent angled top cap bolts and a narrow returner rocking bar are fitted, also water-cooled brasses and the usual hydraulic attachments. The gudgeons were made extra strong. The whole design in short is marked by great strength and an absence of unnecessary complication. The mill is intended to work as third crusher and deal with 1000 tons of canes per 24 hours.

Messrs. Guma & Mejer estimate the coming Cuban crop at 1,165,214 tons. The number of centrals at work is put at 168.

Java's sugar acreage for 1908 is put at 115,243 hectares (284,650 acres), being a slight increase on 1907.

THE NEW SUGAR CONVENTION.

III.

At the time of writing we are still awaiting news of the successful ratification of the patched up arrangements of 28th August and 29th December. The *Exposé des motifs* of the French *Projet de Loi* has been distributed to the Chamber and is interesting reading;—interesting as an indication not only of the disposition to make the best of a bad bargain but also of the determination to ignore its weak points. The document does, however, make bold to say that while the French Government had indulged the hope that the Convention, "which had put an end to a ruinous competition of the principal producing countries," would have been tacitly prolonged without question, they had not found that hope realized. The Government of Great Britain, "on account of peculiar (? Party*) considerations," could not agree with that view, and announced their resolution no longer to penalize bounty-fed sugars. The *Exposé des motifs*, after quoting Sir Edward Grey's despatch of the 1st June, continues: "We cannot help declaring that the suppression by Great Britain of the penalization of bounty-fed sugars was calculated to destroy one of the principal advantages of the Brussels Convention; but between this inconvenience, however grave it might be, and the crisis which would inevitably result from the rupture of the Convention itself, owing to the restoration of the Cartels organised in several producing States, we could not hesitate, and all our efforts have been directed to the maintenance of the Sugar Union."

This plain, unvarnished statement of the dilemma is followed by a clear account of the negotiations and their results. The first article of the Additional Act of 28th August affirms the willingness of the contracting States to maintain the Convention of 1902, in spite of the repudiation by Great Britain of her part in the agreement. It also regulates the duration of the arrangement. Three courses were open; denunciation at a year's notice, an obligatory duration of five years, or a normal duration of five years, but with power of earlier denunciation "if exceptional circumstances render it desirable." This last combination was adopted as giving to commerce the guarantee of stability while giving at the same time power "to meet any exceptional and unexpected situation which the enforcing of the arrangement might create." No cases were specified in which recourse might be had to this power of earlier denunciation, because "no one could anticipate the practical consequences of the new conventional dispositions." This sounds not only reasonable but wise. The Permanent Commission are to decide *by a majority* whether circumstances compel them to give this power to the contracting States. The Commission constitute the organization best

*Perhaps the word *particulières* might be so translated.

qualified to appreciate the measures which circumstances may demand.

Article 2 dispenses Great Britain of her obligation to penalize bounty-fed sugar; but she remains bound by all the other dispositions of the Brussels Convention; she is forbidden to allow bounties, whether in the United Kingdom or her Crown Colonies, or to give on importation any preference to cane sugar over beetroot sugar, or to her colonial sugar over that from the contracting States. And finally she is to admit that the contracting States may demand that sugar refined in the United Kingdom and exported *to their territories* shall be accompanied by a certificate of origin stating that none of the sugar has come from a country which gives bounties on the production or exportation of sugar. The *Exposé des Motifs* wisely makes no comment on this proviso, which, as we have repeatedly pointed out, is of absolutely no value, because the contracting States do not import British refined sugar for two very good reasons, namely, that they are all, or nearly all, large exporters of that commodity, and that the great majority of them exclude all importations of sugar by means of a sufficient surtax, specially fixed for that purpose by the Brussels Convention.

Article 3 fixes 1st February for the ratifications, because that early date permits the continental sugar manufacturers and growers to know their position in good time, in order to be able to regulate in consequence their beetroot contracts.

This Additional Act has maintained "The Sugar Union," and by extending it for five years has secured "its consolidation." But the dispensation accorded to Great Britain was "of a nature to create in favour of Russian sugar a situation which had to be dealt with." It was decided that Russia should maintain her fiscal and customs legislation, but with the clear understanding that this was "without the power to increase the advantages which could arise, in favour of producers, from the maximum sale price fixed, as is well known, for the home market." In consideration of this special régime Russia undertook to limit the amount of her exportations.

Here again the *Exposé des Motifs* maintains a judicious reserve and does not compare the figures "limiting" the Russian exports for the future with the actual figures in the past. Any such comparison would at once show that "limitation" is not a very suitable word to apply to figures which in reality permit a large increase in Russian exports. The only really apparent limitation is between now and 1st September, 1909. It is well known that owing to large sowings and good weather Russia has had two unusually prolific crops and that, therefore, the stocks of sugar in Russia, which had run down to a very low ebb, have been reconstituted on a large scale, which might be a danger to the international sugar markets. The quantity of sugar which Russia is to be permitted to export, in addition to her

normal exports to Finland, Persia, and the Asiatic land frontier, is to be limited to 300,000 tons for the two years, 1907-9. But this limitation is more apparent than real, because all the sugar which Russia exports before 1st September, 1908, will be her normal exports, which are not included in the 300,000 tons. Practically, therefore, Russia is permitted to export, in addition to her normal exports, 300,000 tons during the 12 months ending 1st September, 1909. That sugar will mostly come to the United Kingdom and will shut out or compete with an equivalent quantity of French, German and Austrian white sugar.

The *Exposé des Motifs* expresses the hope that at the end of the five years, 1908-13, Russia will be prepared to enter the Convention, if it is again renewed, on more reasonable terms. We are certainly inclined to think that if Russia really exports 200,000 tons of extra sugar every year during that period very strong measures will be taken in 1913 to compel her to come in.

We are indebted to the *Journal des Fabricants de Sucre* of the 22nd January for some interesting details of the views expressed in Germany with regard to the Russian arrangement. The Committee of the Association of the German Sugar Industry had already, in December, declared that the conditions for the accession of Russia to the Convention would have prejudicial consequences for the exportation and industry of Germany. On that ground they claimed that the duty on consumption should be reduced from 14 to 10 marks per 100 kilos.

The organ of the industry, *Die Deutsche Zuckerindustrie*, which has from the first been strongly opposed to the concession made to England with regard to the penal clause, is now equally opposed to the favourable treatment conceded to Russia. It particularly objects, also, to the reserves made by England concerning the limitation of Russian exports. England, in its importation of Russian sugar, declines to take any account of the quantity fixed by the New Convention. If Russian sugar comes to the United Kingdom from a German port it appears in British statistics as an importation of German not of Russian sugar. The international control of Russian exports becomes, therefore, by the action of England, very difficult. The figures given by the Russian administration are not sufficient, because the final destination of Russian sugar is unknown at the moment when the product crosses the frontier.

Italy, moreover, has made reserves, and claims the right to postpone to some future time her definite adhesion to the agreement with Russia. If Italy were to retire from the Convention she would gain the privilege of exporting bounty-fed sugar.

Herr von der Ohe, director of the sugar factory of Egelyn, does not fear Russian competition under the new régime, and regards the acceptance of the amended Convention as better policy than a return to the old state of things. This view is contested by Dr. Bruckner of

Stralsund, who in a long article in *Die Deutsche Zuckerindustrie*, endeavours to refute the argument. He cannot accept the assertion that the growth and production of sugar in Russia is so much less economical than in Germany. He believes that Russia can produce sugar at a much lower price than is generally supposed, and, with the help of high indirect bounties, the Russian industry is already making its injurious effect on British markets felt in Germany. English buyers are refusing to buy in Germany for the latter part of 1908, declaring that they will then be able to get—Convention or no Convention—Russian white sugars at the price of German raw sugars. This Russian competition manifests itself not only in England but also in Persia and Turkey, throwing back German and Austrian sugar to find other outlets or to oppose these two products, one against the other, on other markets.

The remedy he proposes is to raise the surtax on 1st September, 1908, and add special countervailing duties on bounty-fed sugar. The German industry could then reconstitute the Cartel and assure itself of a moderate benefice. If the consumption duty could at the same time be lowered that would be better still; he feared, however, that that reform was yet far off. If the Convention is accepted, he concludes, the struggle of competition will be aggravated, and will impose on Germany great sacrifices; agriculture will suffer, the smaller factories, or those badly situated, will go to the wall, while Russia will continue, as in recent years, to build new ones.

These meditations, if they create any loud echoes in the Reichstag, may lead to an interesting discussion. At present we know, from the news of the 25th January, that the Supplementary Act of the Convention came up for discussion in the Reichstag on the 24th and was eventually referred to a Committee of 28 Members. The Secretary to the Treasury declared that the Federal Governments were ready to consider the question of a reduction of the consumption duty. They were resolved, if the Supplementary Act came into effect, to lay before the House a measure for reducing the duty from 14 to 10 marks per 100 kg. Some other source of revenue would have to be found to compensate for any deficiency.

The Times correspondent gives a somewhat different complexion to Baron von Stengel's speech and makes him say that, as regards a reduction of the consumption duty, "there could be no question of giving effect to this proposal for the next few years, since the decrease of revenue which would result from a reduction of the sugar tax would have to be met by a corresponding increase in the revenue from other sources."

This reduction of the German consumption duty is a most important element in the sugar question of the moment, and we are inclined to believe that the German Government will make a determined effort to carry it out and thus come to the rescue of a highly important agricultural and manufacturing industry.

THE SUGAR CONVENTION, 1902, AND Mr. BOWLES.

Some correspondence has recently taken place in the columns of the *Morning Post* on the 1902 Sugar Convention in which Mr. Gibson Bowles and Mr. George Martineau, C.B., took a leading part. Mr. Martineau's last letter put the case admirably for the Convention and we think we can venture without any apology to reproduce it for our readers' benefit, well as the latter have been kept posted up on the subject.

TO THE EDITOR OF THE MORNING POST.

Sir,—If your readers are not tired of the subject I should like to be permitted to intervene in this discussion in order to set at rest some disputed facts and put the case briefly in its real aspect for the information of the puzzled general reader. Thirty-five years of almost continuous labour in dealing with the complicated details of this international question, coupled with great opportunity for thinking out its economic aspect and discussing the same with many eminent economists and statesmen of the period, give one some claim to the attention and confidence of those who desire to know the truth. Mr. Bowles is quite right in saying that everyone must "beware how he uses statistics, the origin, character, meaning, and innumerable qualifications whereof he has not wholly understood." This fact is constantly coming home to us who pass our lives in the conduct and study of a great industry, and in the still more difficult study of market fluctuations and their causes. When those who have not had the advantage of this process of laboratory research rush in and pose as experts in the science they are apt to fall into grievous errors and very often resent correction.

Let us see what the facts are. The Sugar Bounties artificially stimulated a natural and beneficent industry in a small portion of the Continent of Europe until it grew out of all bounds and supplied more than two-thirds of the visible consumption of the world. When there was a deficient beetroot crop in this comparatively limited area the whole world had to pay a great deal more than the natural price based on the cost of production. This advance sometimes amounted to 50 or even 100 per cent. At other times the artificial stimulus of the bounties acted in the opposite direction, when there was a good crop and glutted markets. Then we had a fall below cost price. This discouraged all other producers, and their share in supplying the world's ever increasing consumption stood still or fell off. The result was that when consumption had overtaken production there was not enough sugar and prices rose. But each time that this occurred the bounty-fed industry got a larger and larger share in supplying the world's demands; nearer and nearer, in fact, to a monopoly. During the bounty period, therefore, there were constant fluctuations between over-production and a deficient supply; that is, between excessively low and excessively high prices. The average price of the bounty period was therefore much higher than the price will be when it is based on the natural cost of production.

At the time when the Convention was signed we had come to a crisis in the history of the Sugar Bounties. To the direct and indirect bounties of

former days had been added the enormous Cartel Bounties in Germany and Austria, which threatened to swamp all the others and give to those two countries something approaching to a monopoly. Markets were so glutted that prices fell to a figure three shillings per cwt. below the average cost of production in Europe. If bounties had continued all natural production of sugar would have gradually disappeared. No producer cares to go on producing at a loss of 3s. per cwt. To anyone but a millionaire it is impossible. It is evident therefore that if matters had been allowed to take their course there would have been eventually a great scarcity of sugar and a very high price. As it was, and quite apart from the Convention, the beetroot industries on the Continent very naturally reduced their sowings, and prices recovered from 6s. to 8s. 6d. per cwt. for 88 per cent. raw beetroot sugar. Then came the Convention into force in September, 1903, and, there being a fairly good crop, prices fell away from month to month until the summer and autumn of 1904, when it became apparent that there would be a greatly deficient crop owing to drought. The actual deficiency turned out to be 1,200,000 tons and prices naturally rose. Speculators as usual rushed in and forced up the price to a ridiculous figure. The beetroot industry naturally sowed a record area in 1905, there was an exceptionally good crop, and prices fell back to the low figure which prevailed during the first six months of the Convention régime.

There are many morals to be drawn from this tale, but I have filled enough of your valuable space. I tell the story in order to show how necessary it is even for Mr. Bowles to master "the origin, character, meaning, and innumerable qualifications" of the statistics he ventures to use.

Yours, &c.,

George Martineau.

Gomshall, Surrey, January 3rd.

THE USE OF THE ABBE REFRACTOMETER FOR THE DETERMINATION OF DRY SUBSTANCE IN CANE JUICE AND ALL SUGAR-HOUSE PRODUCTS OF THE JAVA SUGAR INDUSTRY.

By H. C. Prinsen Geerligs,

Pekalongan.

At the suggestion of Mr. Hugh Main* I studied the determination of dry substance in sugar solutions with the Abbe Refractometer and started with the determination of the refractive index of pure solutions at the temperature of 28 degrees Centigrade.

The figures for the readings and the corrections for temperature are given below and it at once appears that they do not differ from those of Messrs. Tolman and Smith† and of Mr. H. Main* when account is taken of the different temperature at which they are made.

* *International Sugar Journal*, 1907.

† *Journal of the American Chem. Society*, 1906. 1480.

Index.	Per cent. Dry Substance.	Decimals.	
1·3335	1	0·0001 = 0·05	0·0010 = 0·75
1·3349	2	0·0002 = 0·1	0·0011 = 0·8
1·3364	3	0·0003 = 0·2	0·0012 = 0·8
1·3379	4	0·0004 = 0·25	0·0013 = 0·85
1·3394	5	0·0005 = 0·3	0·0014 = 0·9
1·3409	6	0·0006 = 0·4	0·0015 = 1·0
1·3424	7	0·0007 = 0·5	
1·3439	8	0·0008 = 0·6	
1·3454	9	0·0009 = 0·7	
1·3469	10		
1·3484	11	0·0001 = 0·05	
1·3500	12	0·0002 = 0·1	
1·3516	13	0·0003 = 0·2	
1·3530	14	0·0004 = 0·25	
1·3546	15	0·0005 = 0·3	
1·3562	16	0·0006 = 0·4	
1·3578	17	0·0007 = 0·45	
1·3594	18	0·0008 = 0·5	
1·3611	19	0·0009 = 0·6	
1·3627	20	0·0010 = 0·65	
1·3644	21	0·0011 = 0·7	
1·3661	22	0·0012 = 0·75	
1·3678	23	0·0013 = 0·8	
1·3695	24	0·0014 = 0·85	
1·3712	25	0·0015 = 0·9	
1·3729	26	0·0016 = 0·95	
1·3746	27	0·0001 = 0·05	0·0012 = 0·6
1·3764	28	0·0002 = 0·1	0·0013 = 0·65
1·3782	29	0·0003 = 0·15	0·0014 = 0·7
1·3800	30	0·0004 = 0·2	0·0015 = 0·75
1·3818	31	0·0005 = 0·25	0·0016 = 0·8
1·3836	32	0·0006 = 0·3	0·0017 = 0·85
1·3854	33	0·0007 = 0·35	0·0018 = 0·9
1·3872	34	0·0008 = 0·4	0·0019 = 0·95
1·3890	35	0·0009 = 0·45	0·0020 = 1·0
1·3909	36	0·0010 = 0·5	0·0021 = 1·0
1·3928	37	0·0011 = 0·55	
1·3947	38		
1·3966	39		
1·3984	40		
1·4003	41		
1·4023	42	0·0001 = 0·05	0·0012 = 0·6
1·4043	43	0·0002 = 0·1	0·0013 = 0·65
1·4063	44	0·0003 = 0·15	0·0014 = 0·7
1·4083	45	0·0004 = 0·2	0·0015 = 0·75

Index.	Per cent. Dry Substance.	Decimals.	
1·4104	46	0·0005 = 0·25	0·0016 = 0·8
1·4124	47	0·0006 = 0·3	0·0017 = 0·85
1·4145	48	0·0007 = 0·35	0·0018 = 0·9
1·4166	49	0·0008 = 0·4	0·0019 = 0·95
1·4186	50	0·0009 = 0·45	0·0020 = 1·0
1·4207	51	0·0010 = 0·5	0·0021 = 1·0
1·4228	52	0·0011 = 0·55	
1·4249	53		
1·4270	54		
1·4292	55	0·0001 = 0·05	0·0013 = 0·55
1·4314	56	0·0002 = 0·1	0·0014 = 0·6
1·4337	57	0·0003 = 0·1	0·0015 = 0·65
1·4359	58	0·0004 = 0·15	0·0016 = 0·7
1·4382	59	0·0005 = 0·2	0·0017 = 0·75
1·4405	60	0·0006 = 0·25	0·0018 = 0·8
1·4428	61	0·0007 = 0·3	0·0019 = 0·85
1·4451	62	0·0008 = 0·35	0·0020 = 0·9
1·4474	63	0·0009 = 0·4	0·0021 = 0·9
1·4497	64	0·0010 = 0·45	0·0022 = 0·95
1·4520	65	0·0011 = 0·5	0·0023 = 1·0
1·4543	66	0·0012 = 0·5	0·0024 = 1·0
1·4567	67		
1·4591	68		
1·4615	69		
1·4639	70		
1·4663	71		
1·4687	72		
1·4711	73	0·0001 = 0·0	0·0015 = 0·55
1·4736	74	0·0002 = 0·05	0·0016 = 0·6
1·4761	75	0·0003 = 0·1	0·0017 = 0·65
1·4786	76	0·0004 = 0·15	0·0018 = 0·65
1·4811	77	0·0005 = 0·2	0·0019 = 0·7
1·4836	78	0·0006 = 0·2	0·0020 = 0·75
1·4862	79	0·0007 = 0·25	0·0021 = 0·8
1·4888	80	0·0008 = 0·3	0·0022 = 0·8
1·4914	81	0·0009 = 0·35	0·0023 = 0·85
1·4940	82	0·0010 = 0·35	0·0024 = 0·9
1·4966	83	0·0011 = 0·4	0·0025 = 0·9
1·4992	84	0·0012 = 0·45	0·0026 = 0·95
1·5019	85	0·0013 = 0·5	0·0027 = 1·0
1·5046	86	0·0014 = 0·5	0·0028 = 1·0
1·5073	87		
1·5100	88		
1·5127	89		
1·5155	90		

Table of Corrections for the Temperature.

Temperature of the Prisms in ° C.	Dry Substance.												
	0	5	10	15	20	25	30	40	50	60	70	80	90
	Subtract.												
20	0·53	0·54	0·55	0·56	0·57	0·58	0·60	0·62	0·64	0·62	0·61	0·60	0·58
21	0·46	0·47	0·48	0·49	0·50	0·51	0·52	0·54	0·56	0·54	0·53	0·52	0·50
22	0·40	0·41	0·42	0·42	0·43	0·44	0·45	0·47	0·48	0·47	0·46	0·45	0·44
23	0·33	0·33	0·34	0·35	0·36	0·37	0·38	0·39	0·40	0·39	0·38	0·38	0·38
24	0·26	0·26	0·27	0·28	0·28	0·29	0·30	0·31	0·32	0·31	0·31	0·30	0·30
25	0·20	0·20	0·21	0·21	0·22	0·22	0·23	0·23	0·24	0·23	0·23	0·23	0·22
26	0·12	0·12	0·13	0·14	0·14	0·14	0·15	0·15	0·16	0·16	0·16	0·15	0·14
27	0·07	0·07	0·07	0·07	0·07	0·07	0·08	0·08	0·08	0·08	0·08	0·08	0·07
	Add.												
29	0·07	0·07	0·07	0·07	0·07	0·07	0·08	0·08	0·08	0·08	0·08	0·08	0·07
30	0·12	0·12	0·13	0·14	0·14	0·14	0·15	0·15	0·16	0·16	0·16	0·15	0·14
31	0·20	0·20	0·21	0·21	0·22	0·22	0·23	0·23	0·24	0·23	0·23	0·23	0·22
32	0·26	0·26	0·27	0·28	0·28	0·29	0·30	0·31	0·32	0·31	0·31	0·30	0·30
33	0·33	0·33	0·34	0·35	0·36	0·37	0·38	0·39	0·40	0·39	0·38	0·38	0·38
34	0·40	0·41	0·42	0·42	0·43	0·44	0·45	0·47	0·48	0·47	0·46	0·45	0·44
35	0·46	0·47	0·48	0·49	0·50	0·51	0·52	0·51	0·56	0·51	0·53	0·52	0·50

We know from the researches of Stolle and of Tolman and Smith that the refractive indices of sucrose, glucose, and fructose are practically the same, so that the amount of dry substance in solutions of these three sugars may be deduced from the same table for the comparison of dry substance and refractive index.

As in juices and syrups, molasses and other products these sugars are accompanied by other bodies, I thought it advisable to study the influence of these too on the refractive index in order to make it clear whether the amount of dry substance in solutions of sugar-house products can be determined in the same way as that in solutions of pure sugars, and if not, what relation might be found between refractive index and dry substance of these impure solutions.

I must here make the observation that my aim was to find a method for the determination of the real dry substance and not for the degrees Brix, which is quite another thing. As everybody knows the degrees Brix only agree with the figure for dry substance when pure sucrose is dissolved in pure water, or at least when the dissolved bodies happen to have the same specific gravity in solution as sucrose. This is however not the case with different non-sugars, inorganic bodies especially making a great difference.* Therefore the difference between dry substance and degrees Brix will amount even to as much as six and more units in molasses containing much salt. This is a cause of much uncertainty in the calculation of the quotient of purity and the figure for the calculated centrifugal yield or for the available sugar, which are generally deduced from the figure for the quotient. Owing to this disadvantage we have often suggested leaving the Brix readings alone and using the figures for real dry substance instead, but the direct estimation of dry substance by desiccation is too troublesome an operation to be made regularly and accurately in a sugar factory. So we had to stick to the Brix readings till the use of a refractometer for this estimation was brought to our notice. Now if the refractive indices will not give us more than the old Brix figures, it is not worth the while to go in for refractometric research; we have got these already and we are not content with them, but if they will give in some way or other the actual dry substance, then we may welcome them as providing a long-felt want. With these figures we can easily find the actual quotient and thus calculate with much more accuracy the centrifugal yield and the available sugar from masse-cuites or syrups. Sometimes friends told me that they tried the refractometer but were not satisfied with it, because its readings did not at all accord with those of their Brix spindles, but after what has been said here, we can conclude that this is more a compliment to the refractometric method than a reflection on it.

* *Inter. Sugar Journal*, 1906, p. 87.

In order to ascertain in which way the solutions of divers non-sugars refracted the light beams, I analysed by means of an Abbe refractometer at the temperature of 28° C., solutions of a number of non-sugars present in the usual cane sugar-house products.

I started by confirming the results of Stolle and of Tollman and Smith, viz., that for all practical purposes the refractive indices of sucrose, glucose and fructose are alike, as well in solutions of the pure bodies as in mixtures of the three, so that mixtures of the three sugars of the sugar cane, when examined by the refractometer, give the same results as if they consisted of sucrose alone, the substance for which the tables are made. Gummy matter, nitrogenous bodies, caramel and the like, cannot cause considerable deviations, because most of them are only present in such insignificant proportions, and besides are, from a chemical point of view, closely related to sugar.

So it is chiefly the salts which, in the determination of the degrees Brix, are the main cause of difference between these and the actual dry substance.

With a view to ascertaining the refractive index of a number of solutions of sodium chloride when tested in the refractometer after the manner in which I had already tested the sugar solutions, I determined specific gravity and refractive index of a series of salt solutions, and calculated from the figures obtained, after correcting them for the temperature, to which percentage of dry substance they were equivalent if the solution had contained pure sugar only.

Per cent. of Sodium Chloride.	Specific gravity at 28° C.	Specific gravity at 17·5° C.	Refractive Index at 28° C.	Dry Substance after Degrees Brix.	Dry Substance after Refractive Index.
1	1·0024	1·00976	1·3348	2·5	1·95
5·2	1·03599	1·03806	1·3422	9·5	6·9
7·3	1·05064	1·05318	1·3445	13·1	8·4
10·8	1·07662	1·07928	1·3513	19·1	12·8
12·8	1·09140	1·09458	1·3552	22·5	15·4
18·9	1·13934	1·14227	1·3655	32·6	21·7
22·8	1·16920	1·17225	1·3737	38·6	26·5
27·8	1·18772	1·18772	1·3767	42·2	28·1

We notice that solutions of sodium chloride when tested with the Brix hydrometer yield a much greater difference with the actual dry substance than when tested with the refractometer, so that the latter has a greater chance of giving correct readings than the former when sucrose solutions containing salt are analysed.

I repeated the experiments with other salts, but omitted the Brix readings as the degrees Brix of most salt solutions are already familiar to most of my readers.

Per cent.	Refractive index.	Dry substance after the tables for sucrose.	Per cent.	Refractive index.	Dry substance after the tables for sucrose.
		POTASSIUM CHLORIDE.			
10·16	1·3457	9·2	2·69	1·3358	2·6
5·12	1·3390	4·9	1·39	1·3340	1·3
		CALCIUM CHLORIDE.			
9·19	1·3548	15·1	2·41	1·3380	4·05
4·81	1·3435	7·8	1·22	1·3353	2·3
		SODIUM SULPHATE.			
11·81	1·3495	11·7	3·22	1·3370	3·4
6·33	1·3414	6·35	1·65	1·3345	1·75
		POTASSIUM SULPHATE.			
10·14	1·3441	8·1	2·69	1·3350	2·05
5·23	1·3382	4·2	1·27	1·3337	1·1
		SODIUM ACETATE (anhydrous).			
10·00	1·3460	9·4	2·57	1·3359	2·75
5·10	1·3394	5·0	1·30	1·3340	1·3
		POTASSIUM ACETATE.			
9·80	1·3440	8·05	2·60	1·3353	2·25
5·00	1·3382	4·2	1·50	1·3340	1·3
		CALCIUM ACETATE.			
9·48	1·3490	11·4	2·50	1·3364	3·0
4·79	1·3408	5·95	1·26	1·3345	1·75

From these figures we conclude that with equal concentrations the calcium salts have a higher index than sucrose, that sodium salts have rather equal indices, whilst those of potash salts are lower. Since in cane sugar products the salts consist exclusively of potash and lime salts, it is not impossible that they neutralize each other's deviations, causing the complex of salts to yield in solution indices which fairly concord with those of sucrose solutions of the same concentration as that of the salts.

Here it would be necessary that the index of the mixed solution be the average of the indices of the components, and further that it be not altered by the presence of sugars.

In order to make this point clear I mixed equal weights of approximately 10% solutions of sodium and potassium acetate, which had been used in the previous experiments, and determined the index of the mixture, which was found to be 1·3449, while the calculated average was $(1{\cdot}3440 + 1{\cdot}3460) \div 2 = 1{\cdot}3450$, or just the reading itself.

In a second experiment, one part of solution of calcium chloride, having an index of 1·3558 was mixed with one part of a solution of chlorate of potash with an index of 1·3405. The index of the resulting mixture was found to be 1·3481, and the calculated average is $(1{\cdot}3558 + 1{\cdot}3405) \div 2 = 1{\cdot}34815$, or again the very same figure.

It thus appeared that salts which do not give any reaction with each other and do not combine, do not change their index, and therefore I hoped that the mixtures of potash and lime salts might show indices analogous to that of sucrose.

I thereupon made the following solutions :—

Potassium chloride	10·71%	index	1·3465	according to table	9·75
Sodium chloride	10·28	,,	1·3498	,, ,,	11·9
Calcium chloride	9·95	,,	1·3558	,, ,,	15·75
Sodium sulphate	10·05	,,	1·3470	,, ,,	10·05
Sodium acetate..	10·00	,,	1·3460	,, ,,	9·4
Potassium acetate.. ..	9·80	,,	1·3440	,, ,,	8·05
Calcium acetate..	12·56	,,	1·3580	,, ,,	14·0

Further, I prepared a solution containing :—Sucrose 35·3%, glucose 15·6%, and fructose 15·6%, showing an index of 1·4555, or a percentage of dry substance of 66·5%, which in this paper will be named "syrup." 40 grammes of this syrup were mixed with 10 grammes of the sodium acetate solution, and the index of the mixture read in the refractometer; this was 1·4300.

40 grammes of syrup of 1·4555..	58·220
10 grammes of the acetate 1·3460..	13·460
50	71·680
1 part of the mixture	1·4236 or less

than calculated.

The same thing was repeated with 10 grammes of the potassium acetate solution and with 5 grammes of each of the two acetates with these results :—

40 grammes syrup of 1·4555	58·220
10 grammes sol. acet. of potash ..	13·439
50	71·659
1 part	1·4332 calculated

and found to be 1·4300 or again less than the calculated figure.

40 grammes syrup 1·4555	58·220
5 grammes of solution of sodium acetate 1·3439	6·6195
5 grammes of solution of potass. acetate 1·3460	6·730
50	71·5695
1 part	1·4314 calculated.

The figure read in the refractometer was 1·4292 or again less than the calculation.

This proves, that when the salts are dissolved in a sugar solution, the index of the mixture is no more the average of the index of the components but represents the refractive index of a new body having its own refractive power. It is obvious that the salts do not exist in their former state in combination with the sugar, but that they have formed fresh combinations and given rise to new chemical bodies. I

discovered the same thing from other phenomena noticed years ago on which I founded my molasses theory, viz., that in molasses the salts have combined with the sugars to form viscous, uncrystallizable, hydrated compounds, from which the sugar cannot be separated by mechanical means, such as crystallization. I was up till lately unable to furnish the direct proof of the existence of such compounds, but now the phenomena described in this paper give ample proof of the fact that sugar and salts combine in solution.

Next I wanted to know how far the refractive index was to be used as a measure for the amount of dry substance in molasses or in solutions of the salt-sugar combinations and my researches gave me very satisfactory figures.

	Grammes.
40 grammes syrup of 66·5% dry substance	26·60
10 grammes solution of sodium acetate of 10% ..	1·0
50	27·60

or 55·2% dry substance. The refractive index is 1·4300 or according to the table 55·35% dry substance.

	Grammes.
40 grammes syrup of 66·5% dry substance	26·60
10 grammes solution of potassium acetate of 9·80%	0·98
50	27·58

or 55·16% dry substance. The index is 1·4300, corresponding with 55·35%.

	Grammes.
40 grammes syrup of 66·5% dry substance	26·60
5 grammes of solution of sodium acetate of 10%	0·50
5 grammes solution of potassium acetate of 9·80%	0·49
50	27·59

or 55·18%. The index is 1·4292 or according to the tables 55·0%.

The following mixtures were tested in the same way. In the subjoined table I bring together the refractive index, the actual amount of dry substance, and the figure for the dry substance which the solutions should contain according to the tables if they had only contained sugar.

Composition of the Mixtures.	Refractive Index at 28° C.	Actual Dry Substance.	Dry Substance derived from the Tables.
$CaCl_2 + KCl$ (1 + 1)	1·3481	10·33	10·8
Na Acet + K Acet (1 + 1)	1·3419	9·90	8·75
Ca Acet + Syrup (1 + 4)	1·4310	55·71	55·85
KCl + Syrup (1 + 4)	1·4308	55·34	55·7
$NaCl$ + Syrup (1 + 4)..	1·4309	55·26	55·7
$CaCl_2$ + Syrup (1 + 4)	1·4325	55·19	56·5
$CaCl_2$ + K Acet + Syrup (0·5 + 0·5 + 4)	1·4313	55·09	55·95

Finally I investigated the influence of products of decomposition of glucose by lime and alkalies and also of the total of non-sugars left

behind by molasses after fermentation and distilling. For the former purpose I boiled a glucose solution with lime till the glucose was totally destroyed, neutralized the alkaline liquid with a current of carbonic acid, filtered, and divided the solution into three parts. One of these was evaporated and called glucinate of lime, the two others were decomposed respectively with carbonate of soda and of potash, filtered, evaporated and denominated glucinate of soda and glucinate of potash.

The residuum of the distilled molasses was obtained from a distilling house where nothing but cane molasses was fermented.

The solution had the following composition :—

	Na Glucinate.	K. Glucinate.	Ca Glucinate.	Residuum.
Dry Substance	45·6	63·90	55·6	61·8
Ash	8·44	17·67	9·53	22·5
Organic Substance ..	37·16	46·23	47·07	39·3

Ten grammes of each of these were mixed with 40 grammes of the syrup and the refractive index taken.

	Na Glucinate.	K. Glucinate.	Ca Glucinate.	Residuum of fermented and distilled Molasses.
Dry substance of the mixture..	65·04	65·07	64·85	66·03
Refractive index	1·4513	1·4516	1·4520	1·4578
Dry substance after the tables..	64·7	64·85	65·0	67·50

The figures for the calculated dry substance agreed for such impure solutions so well with those found by desiccation that I had every hope that the same result could be met with in the analysis of juices, masse-cuites, &c. Ripe cane juice is to be considered a pure solution of sugar; it contains only very little ash and other matter, we could therefore expect that the estimation of dry substance by the refractometric method would yield the very same figures as the determination by desiccation, but it was still unknown how far this accordance would extend itself to sugar house products and to juice of immature cane. In the tables underneath I have collected the results of experiments with these materials, from which we learn that the readings of the refractometer deviate very little from those obtained by desiccation, and in any case coincide more nearly than did the degrees Brix to which we were accustomed.

Further, it must be borne in mind that the method of desiccation is not beyond suspicion for molasses and products containing so much glucose, and is apt to give wrong figures, because of the retention of moisture by the viscous fluid as well as on account of the driving-off of products of decomposition by the prolonged heating.

If there is a difference between the figure for dry substance by the refractometer, and by desiccation, we are not at all sure that the latter is the correct one. In fact when repeating the determination I often found the identical figure by the refractometer, while the figure by desiccation often varied as much as 0·5% on either side.

Denomination of the sample.	Dilution.	Refractive Index at 28°C.	Dry substance after the Tables.	Dry substance by desiccation.	Degrees Brix.	Calculated original dry substance after the Tables.
Juice of immature cane.	None.	1·3467	9·9	10·0		
		1·3495	11·7	11·64		
		1·3528	13·9	13·7		
		1·3518	13·1	12·96		
		1·3449	8·75	8·68		
		1·3492	11·5	11·44		
		1·3483	10·95	10·79		
		1·3497	11·8	11·54		
		1·3466	9·8	9·64		
		1·3475	10·4	10·20		
		1·3475	10·4	10·29		
Masse-cuite from syrup mixed with returned molasses diluted with their own weight of water.	1 : 1	1·4109	46·25	45·15	41·6	
	1 : 1	1·4085	45·1	43·7	45·3	
	1 : 1	1·4094	45·35	43·9	45·9	
	1 : 1	1·4101	45·85	44·2	46·1	
	1 : 1	1·4092	45·55	44·4	45·9	
	1 : 1	1·4114	46·5	44·9	46·3	
	1 : 1	1·4099	45·8	45·1	46·1	
	1 : 1	1·4083	45·0	44·25	45·6	
	1 : 1	1·4081	44·9	44·12	45·3	
	1 : 1	1·4092	45·55	44·25	45·6	
Masse-cuite from syrup mixed with returned molasses diluted with their own and double their weight of water. (The lines united by a bracket have relation to the same sample.)	1 : 1	1·4114	46·5	45·72	47·1	93·0
	1 : 2	1·3823	31·25	30·44	31·6	93·75
	1 : 1	1·4116	46·6	45·45	..	93·2
	1 : 2	1·3823	31·25	30·40	..	93 75
	1 : 1	1·4114	46·5	45·52	..	93·0
	1 : 2	1·3826	31·4	30·50	..	94·2
	1 : 1	1·4099	45·8	45·27	46·6	91·6
	1 : 2	1·3815	30·75	30·18	31·2	92·25
	1 : 1	1·4095	45·6	44·95	..	91·2
	1 : 2	1·3810	30·5	29·97	..	91·5
	1 : 1	1·4079	44·8	44·47	..	89·6
	1 : 2	1·3803	30·15	29·75	..	90·45
	1 : 1	1·4099	45·8	44·9	..	91·6
	1 : 2	1·3813	30·65	29·87	..	91·95
	1 : 1	1·4118	46·7	45·35	..	93·4
	1 : 2	1·3821	31·15	30·23	..	93·45

Denomination of the sample.	Dilution.	Refractive Index at 28°C.	Dry substance after the Tables.	Dry substance by desiccation.	Degrees Brix.	Calculated original dry substance after the Tables.
Masse-cuite from syrup and returned molasses, diluted with their own or double their weight of water.	1 : 1	1·4122	46·9	45·25	..	93·8
	1 : 2	1·3819	31·05	30·17	..	93·15
	1 : 1	1·4123	46·95	45·17	..	93·9
	1 : 2	1·3827	31·45	30·12	..	94·35
	1 : 1	1·4109	46·25	45·1	..	
	1 : 1	1·4085	45·1	43·7	..	
	1 : 1	1·4094	45·35	43·9	..	
	1 : 1	1·4101	45·85	44·6	..	
	1 : 1	1·4092	45·55	44·4	..	
Molasses either undiluted or diluted with their own or double their weight of water. (The lines united by a bracket have relation to the same sample.)	None	1·4856	78·75	78·85	80·7	78·75
	1 : 1	1·3987	40·15	..	..	80·30
	None	1·4845	78·35	74·6	79·2	78·35
	1 : 1	1·3980	39·8	..	..	79·6
	None	1·4962	82·85	82·8	89·4	82·85
	1 : 1	1·4040	42·85	..	..	85·7
	None	1·5000	84·3	83·1	87·5	84·3
	1 : 1	1·4060	43·85	..	..	87·7
	None	1·4880	79·7	77·85	81·2	79·7
	1 : 1	1·3988	40·2	..	..	80·4
	1 : 2	1·3753	26·4	..	..	79·2
	None	1·4774	75·5	74·85	77·57	75·5
	1 : 1	1·3975	39·45	..	..	78·9
	1 : 2	1·3738	26·6	..	..	79·8
	None	1·4991	84·0	82·05	87·3	84·0
	1 : 1	1·4069	44·3	..	..	88·6
	1 : 2	1·3795	29·7	..	..	89·1
Exhausted Molasses	None.	1·4799	76·5	76·31	81·02	
		1·4848	78·45	76·55	83·07	
		1·4914	81·0	79·20	82·86	
		1·4844	78·3	76·75	81·48	
		1·4883	79·8	78·25	82·45	
		1·4980	83·5	82·10	86·70	
		1·4979	83·5	83·75	89·18	
		1·4867	79·2	77·0	..	
		1·5010	84·65	82·80	88·32	
		1·4910	80·85	78·0	82·60	

These experiments led me to recommend the refractometer as a reliable instrument to determine in a very small portion of the sample in a simple and rapid way the actual amount of dry substance in all products of the cane sugar industry; but there still remained a doubt whether there did not exist a condition or a group of conditions, where the composition of the juice differed from the already analysed ones. In order to settle this, I asked for samples of the waste molasses of every cane sugar factory in Java and extended my researches to over a hundred samples of exhausted molasses from every part of the island. The reason why I only examined the waste molasses was, that this is the product in which most of the non-sugar is accumulated, so that if this can safely be tested with the refractometer the purer products of course will be admissible. The figures obtained in the estimation of dry substance by refraction and by desiccation will be found in the tables underneath.

All the samples were tested without dilution, only one of the molasses was so dark that it was impossible to get a sharp shadow line in the refractometer, but after dilution with an equal weight of water the estimation of the dry substance could be made without trouble.

In every case the difference between the two figures was so insignificant for the low grade products, for which they were stated, that they do not seriously affect the quotient of purity, for the calculation of which they are destined. The greatest difference is found in the molasses of Winongan estate, and if we assume the polarization of that molasses to be 28, then the quotient calculated with the lowest figure for the dry substance 32·30 amounts to 33·32, and that with the highest of 34·90 to 32·93, or even in this extreme case no more than 0·94.

As the juices, syrups, dissolved masse-cuites, &c., when tested in the refractometer, yield figures that are identical with the actual dry substance dissolved, whilst those yielded by impure molasses differ from those obtained by desiccation only in quantities which are still within the limits of the analysis, I venture to recommend the refractometer as a reliable instrument to estimate in every normal case the actual dry substance dissolved in all products of the cane sugar industry which are fit for this method of analysis.

This is not only an advantage in that it will rid us of the Brix hydrometers and of their tables of corrections, the huge quantities of material required, and the necessary dilutions and cooling of molasses, and other concentrated liquids; but it does away at the same time with the apparent dry substance, and the apparent quotient of purity, and therefore enables us to calculate with great accuracy the available sugar, the centrifugal yield, and the unaccountable loss of sucrose.

Estates.	Dry Substance by Refractive Index.	Dry Substance by Desiccation.	Difference.	Estates.	Dry Substance by Refractive Index.	Dry Substance by Desiccation.	Difference.
Adievema	82·92	82·30	—0·62	Ngandjoek	77·22	79·15	1·93
Alkmaar	79·05	78·45	—0·60	Ngelom	83·55	83·25	—0·30
Asembagoes	86·76	87·30	0·54	N. Fersana......	83·95	84·00	0·05
Badas	82·00	81·90	—0·10	Oemboel	81·92	82·50	0·62
Balong Bendo ..	88·55	87·05	—1·50	Olean	82·33	81·50	—0·83
Balapoelang	78·01	80·00	1·99	Padjarakan......	81·45	81·00	—0·45
Bagoe	82·57	82·30	—0·27	Pagongan	75·20	76·50	1·30
Bangsal	80·66	80·65	—0·01	Pangka	78·90	80·45	0·55
Bandjardawa	79·40	80·35	0·95	Pesantren	83·02	82·55	—0·57
Bantvel	84·40	84·30	—0·10	Peterongan	85·66	85·45	—0·21
Barongan	82·48	84·00	1·52	Pverwoadri	84·73	84·80	0·07
Bodjong	81·46	82·30	0·84	Poerwo kerito ..	82·00	81·90	—0·10
Boedoeran	80·80	81·30	0·50	Redjosari	80·85	81·20	0·35
Bogot-Kidvel	79·00	80·85	1·85	Remboen........	80·48	80·35	—0·13
Demak Idjoe	77·92	76·65	—1·27	Seborot	81·79	82·85	1·06
Djati	80·19	81·90	1·71	Sedati	84·86	85·40	0·64
Djati barang	83·10	85·00	1·90	Seleredjo........	84·36	84·90	0·54
Gajam..........	81·01	82·55	1·54	Sempal Wadak ..	85·94	86·65	0·61
Garvem	84·25	83·50	—0·75	Sentanen lor	78·34	80·05	1·71
Gemoe..........	82·77	83·20	0·43	Serroe Galver....	83·53	81·70	—1·83
Gending	82·43	82·35	—0·08	Sindanen lavet ..	82·27	83·45	1·18
Goedo	77·86	79·65	0·79	Soekodhono L. ..	82·03	82·65	1·45
Kabat	83·35	84·20	0·85	Soekodhono M...	79·75	81·30	0·62
Kadhipaten	81·95	82·00	0·05	Soemberkareng ..	74·23	75·35	1·12
Kalibagor	80·00	81·15	1·15	Soeraminangon ..	86·05	84·75	—1·30
Kalimati........	83·65	84·30	0·65	Sraji	85·87	86·60	0·73
Kali woenggoe ..	80·95	82·35	1·40	Srvenie	84·10	84·40	0·30
Kanigoro	83·46	83·15	—0·31	Tandijong Modjo.	81·24	81·35	0·11
Karang Anom ..	77·69	78·35	0·66	Tandijong Firto..	80·94	80·80	—0·14
Kawarassan	85·27	84·80	—0·47	Tangarang	81·79	82·50	0·71
Kedawoeng	82·97	83·65	0·68	Tangoengan	80·24	80·8	0·56
Kemanglen	83·70	83·60	—0·10	Tegowangi	84·78	84·0	—0·78
Kentjong	81·20	81·70	0·50	Tjepiring	80 33	82·20	1·87
Ketanggoengan..	85·96	84·35	—0·61	Tjepper	81·17	82·50	1·33
Ketejan	79·30	80·45	1·15	Tjomal	81·34	82·0	0·66
Klampok	80·70	82·35	1·65	Toelangan	80·79	82·05	1·26
Kon. Willem II..	77·00	79·25	2·25	Trangkil........	79·08	81·15	2·07
Krebet	86·77	86·90	0·13	Warve	78·64	79·80	0·86
Kremboeng	85·48	84·00	—1·48	Winongan	82·80	84·90	2·10
Krian	86·33	84·50	—1·33	Wono Adet......	84·68	84·50	—0·18
Majong	84·90	85·80	0·90	Wonolangan	78·24	80·45	1·51
Maron	81·53	83·45	1·92	Wonopringgo ..	80·31	80·20	—0·11
Menang	83·82	82·85	—0·27	Wonoredjo......	77·46	79·35	1·89
Mingiran	86·04	84·40	—1·64	Wonosari	81·70	82·0	0·30
Modzi pangoeng..	80·22	81·55	1·33				

This refers only to laboratory work, but the refractometer may come into good use in the sugar mill too, in the fixing of the amount of maceration water which is to be poured on the bagasse, in the washing of the scums in the filter-presses, in evaporation, and especially in the boiling of after-products masse-cuites to ascertain whether the proper concentration is obtained or not.

THE GREENOCK REFINERIES.*

In the annual review of the Greenock sugar refining industry, published in this journal at the end of 1906, gratification was expressed on account of the improvement in the volume of trade in the year then closing, which showed an increase of about 44,000 tons over the quantity worked in 1905. Unhappily this expansion has not been maintained during 1907: the quantity put through the Greenock refineries will show a total of only about 162,000 tons, against 188,000 tons in 1906, a decrease of about 26,000 tons, or nearly 14 per cent. The principal cause of this decrease has been the permanent closing of the Cartsburn Refinery; the expectation that it would shortly be re-opened, which existed at the date of our last review, was not fulfilled; the proprietors resolved to wind up the company, and the machinery, &c., has accordingly been catalogued for sale. This refinery was built in 1851 by the late Mr. Lear Wrede, who had previously worked the Dellingburn Refinery, and who was long connected with the sugar trade in Greenock as a refiner and afterwards as a sugar broker. It was the smallest of the refineries recently in active operation in the town, but enjoyed the reputation of turning out some of the best refined sugars produced in this market.

The refineries still working here are now reduced to five in number, exclusive of the extensive works in West Burn Square belonging to the Brewers' Sugar Co., Ltd., who continue successfully to carry on the manufacture of the special products to which their operations are confined. The five sugar refineries in activity are the following: (1) The Orchard Refinery, belonging to the Orchard Sugar Refining Company, the principal partners in which are Mr. James Aitken (the oldest member of the trade), Mr. Andrew Stewart, and Mr. Andrew Downie. This sugar-house was built about 1863 for Messrs. Paul, Sword & Co. (2) The Berryyards Refinery, belonging to the Westburn Refineries, Ltd., which is connected with the Brewers' Sugar Co., Ltd. It was originally built in 1852 by Messrs. Anderson, Orr & Co., and has subsequently been greatly altered and extended. (3) The Drumfrochar Refinery, belonging to Messrs. Neill, Dempster and

* For this interesting statement of the condition of the Greenock refineries we are indebted to an article on "Sugar Refining in Greenock during 1907," which appeared in a recent number of the *Greenock Telegraph*.

Neill, built in 1867 to replace the former works of the firm which were situate in Dellingburn Street and destroyed by fire in 1865. (4) Walker's Refinery, built in 1826 by Messrs. Angus Balderston & Co., and acquired by Messrs. John Walker & Co. about 1850; this sugar-house has been several times burned down, and is now entirely modernized and in every way up to date. (5) The Glebe Refinery, belonging to the Glebe Sugar Refining Co., whose managing partner is Mr. Robert Kerr, the respected chairman of the Scottish Sugar Refiners' Association. This refinery was originally built in 1831, and for some time belonged to Messrs. James Fairrie & Co., who, like some others of the old Greenock firms, afterwards transferred their business to Liverpool. It has been almost entirely rebuilt by the present proprietors. The chances of re-opening the other sugar-houses now silent have practically disappeared. The machinery of the Clyde Refinery has been all broken up and removed during the year. The Dellingburn Refinery, from which the machinery was removed some years ago, has, notwithstanding its exceptionally favourable situation, failed to find a purchaser. And the fine buildings of the Roxburgh Refinery are now in process of demolition.

CROSS-FERTILIZATION OF SUGAR CANES.

In a recently issued pamphlet, entitled "Cane Sugar or Beet," written by Mr. F. I. Scard, F.I.C. (and which, by the way, is mainly devoted to setting forth the points of superiority of cane sugar over beet), the writer gives in a few lines an excellent résumé of the problem which is at present engrossing the attention of cane sugar experts, viz., the advantages of the new system of cross-fertilization of definite varieties of canes over the older system of seedling cane selection. The same subject has been treated at greater length and with considerable technical detail by Mr. Stockdale in his paper, of which the concluding portion appears in this number, and those of our readers who are interested in the subject will study it with profit. But what Mr. Scard says may well be reproduced here.

"Like all members of the 'grass' family, the sugar cane is capable of propagation from seed, but in those varieties which have been cultivated industrially, it has been the custom to reproduce them from cuttings, each joint having a bud, which, in the growing part of the cane is capable, under suitable conditions, of developing into a new cane. In this way the natural methods of reproduction had been lost sight of until quite recently; so much so that it had been generally accepted that the sugar cane could not be propagated from its seed.

"Recent researches have shown, however, that although cultivation leads to a considerable diminution of the fertility of the seed, it is

possible to raise canes therefrom, the difficulty increasing with the degree to which the cane has been cultivated, *e.g.*, the Bourbon, which is one of the most cultivated canes grown, being the most difficult to reproduce in this way. This re-discovered power, however, is now being utilized in the direction of the raising of new varieties of cane, which till recently could only be done by careful selection. So marked is the tendency of the sugar cane to hark back to old types from previous haphazard fertilizations, that this process is attended with an infinity of trouble. It is not an uncommon thing among the hundreds of seedlings which may germinate from the sowing of a single 'arrow' for almost as many different features to be shown. The observation of these seedlings through the earlier stages of their life, and the selection of the fittest during the observation of several years in the nursery and educational periods until the best are sent out to the estates for practical trials, forms one of the most arduous studies of the tropical chemist and botanist. It is not too much to say that the dozen or thereabouts of new varieties which are being cultivated on estates in the West Indies represent selections from hundreds of thousands of seedlings. Recently, however, efforts have been made to cross-fertilize known varieties, a botanical feat the difficulties of which were looked upon, until lately, as insurmountable, and it is hoped that in this way an enormous amount of labour may be saved, and definitely pedigreed canes obtained, although the tendency to atavism mentioned above will always be a source of trouble."

SUGAR IN 1907.

Messrs. J. W. de Silva & Co. in a recent report state:—The year 1907 opened with prompt beet at 8s. 9½d. and first marks granulated at 10s. 7½d. per cwt. f.o.b. Hamburg and a general expectation of lower prices, based upon the supposition that the beet crop would exceed the current estimates, that the Cuban crop would approximate 1,400,000 tons, and that the apparent consumption would be much smaller than that of the previous season. Prices however being below cost of production, continental holders were unwilling sellers, and though both the beet and Cuban crops realized the maximum estimates, prices after declining to 8s. 7d. for beet and 10s. 3¾d. for granulated slowly advanced. In March and April demand in the United Kingdom was limited in consequence of the impression that the duties upon the article would be abolished, but prices continued to improve as it was becoming evident that the world's consumption was not going to show the anticipated decrease, and the prices ruling had prevented the increase in sowings necessary to provide for the requirements of 1908. Although the Budget made no change in the duties, demand, helped by a good supply of fruit, steadily increased,

and prices advanced until in July prompt beet sold at 10s. 2¼d. and granulated at 11s. 8¼d. per cwt. The announcement by the British Government that they would withdraw from the Brussels Convention unless they were relieved from enforcing the penal clause, created the idea that the Convention would not be renewed, and though this could not occur until 1st September, 1908, and the prospect of a resumption of bounties was in any case very improbable, free selling caused beet to decline to 9s. 5d. and granulated to 11s. per cwt. On it becoming known that the delegates recommended that the United Kingdom should be allowed to remain a party to the Convention without being required to enforce the penal clause, the pressure to sell ceased, demand, helped by a large supply of stone fruit, became large and with unfavourable reports of the growing beet crops, prices advanced to 10s. 3d. for beet and 12s. for granulated. Favourable weather for the beet crop in October led to free offerings of new crop sugars, especially by Dutch refiners, and values declined until in November beet sold at 9s. 2¼d. and granulated at 10s. 9d. per cwt. From these values prices gradually recovered as it was becoming evident that a beet crop of about 6,500,000 tons and a Cuban crop 200 to 300,000 tons less than the last one was not sufficient to provide for the normal annual increase in the world's requirements, which for the past ten years has exceeded 500,000 tons per annum. The year closed with beet at 9s. 10½d. and granulated at 11s. 6d. per cwt.

Consumption in the United States during 1907 is estimated to have been 2,994,000 tons, or 130,000 tons more than in 1906. That of the present year must be estimated at 3,100,000 tons, to supply which the following quantities may be available:—

		Tons.
Stock, 1st January (including New Orleans) ..		210,000
United States beet	say	450,000
Cuba	,,	1,050,000
Porto Rico..	,,	220,000
Hawaii	,,	420,000
Louisiana (next crop)	,,	320,000
Other sources	,,	130,000
		2,800,000
Necessary Stocks		150,000
		2,650,000
Required from Java and Europe		450,000

We learn that Mr. William Ramsdale Bardsley has become a partner in the firm of Hinton & Sons, Sugar Manufacturers, Madeira.

THE CANE SUGAR INDUSTRY OF BRAZIL.

The sugar industry of Brazil is a very ancient one, for it dates from the time of the first attempts at colonization by the Portuguese in 1531; the latter introduced the sugar cane from Madeira and started the first *engenho* (driven by water-power) in the Isle of St. Vincent, a part of the State of Sao Paulo.

These first attempts were clearly crowned with success, for some fifty years later there were some 120 sugar *engenhos* in existence in Brazil; by 1628 this number had increased to 235, representing a reproduction of 25,000 *caixas* of 30 *arrobas* (1 *arroba* = 14·7 kg. or 32·4 lbs.). Since then this aggregate has increased steadily down to the present day when there are approximately 4000 usines and open pan factories (bangues) situated according to the accompanying table :—

	Usines working			Engenhos or Bangues.	Total.	Total Production.	
	Diffusion.	Single Crushing.	Double Crushing.			Metric Tons.	Sacks (60 Kg.).
Pernambuco	1	40	6	1,500	1,547	156,000	2,600,000
Alagoas	..	4	3	850	857	36,000	600,000
Sergipe	..	15	1	650	666	30,000	500,000
Bahia	..	2	21	200	223	18,000	300,000
Parahyba Norte ..	..	2	..	100	102	4,000	70,000
Rio Grande Norte..	..	1	..	150	151	4,000	80,000
Maranhao	..	2	1	60	63	3,000	50,000
Rio de Janeiro ..	1	35	5	30	71	27,000	460,000
Sâo Paulo	1	6	5	20	32	15,000	250,000
Minas	..	3	..	50	53	2,000	40,000
Other States ...	..	5	..	230	235	3,000	50,000
	3	115	42	3,840	4,000	298,000	5,000,000

The mean total production of these usines, engenhos and bangues may be placed at approximately 300,000 tons of sugar of all classes, corresponding to five million sacks of 60 kilos each.

The State of Pernambuco, with its 1547 usines and bangues, is without question the premier sugar state of Brazil; but the State in which the manufacture of sugar has attained the greatest degree of perfection is that of Bahia in which nearly all the mills possess double crushing; next in these respects comes the State of Sao Paulo which,

while not possessing by any means a large production, nevertheless contains the most modern usines in the Confederation.

If we study the varieties of canes in general use in Brazil, we shall see how greatly they differ according to the particular State, the diverse climates requiring distinct species. Thus the Northern sugar zone requires exclusively canes of the white or green varieties such as *Cayenne*, *Cristallina*, *Salangore*, *Amarella*, *Bamboo*, *Imperial*, &c., species which all demand a hot and dry climate. Some districts, however, cultivate canes such as the *Lousier*, *Bois-Rouge*, *Ferrea*, but these species are tending to disappear as they do not give a satisfactory saccharine yield.

The central zone, consisting of the State of Rio de Janeiro, cultivates some species of green canes, but the majority of the estates are planted with red canes.

Lastly, in the State of Sao Paulo which comprises the third sugar zone of Brazil, three-quarters of the canes belong to the *Lousier* or *Bois-Rouge* variety which are just suited to the temperate climate of this State. A determined attempt is, however, being made here at the present moment to acclimatize certain other species possessing considerable purity and high saccharine content, besides being more resistant to disease than the green canes; they belong to the "Riscada" and "Rose" varieties.

As regards the mode of cultivation, the first two zones differ very little in their methods, for both have retained the old *covas* system of planting which dates from the introduction of the sugar cane into Brazil. This operation consists in digging holes in the soil about 1·50 m. apart and 20 cm. deep, in which are placed pieces of cane about 20 cm. long. The holes (or *covas*) are then refilled with earth without any manuring; five weeks later a light loosening is done, and then without any further labour the exceptional climate of these regions undertakes to produce in fifteen months splendid crops of canes three to four metres in height having a saccharine content of as much as 20%, and proving the wonder and admiration of all travellers visiting the country. Nevertheless it must be observed that certain proprietors of a more enterprising turn of mind have commenced to employ modern agricultural implements and to use natural manures.

In the third zone the conditions are entirely different; the cultivation is here a rational one and, generally speaking, it can be said that within recent years the State of Sao Paulo has taken the premier place among the States of Brazil in sugar cultivation, thanks to the efforts of the local government as well as to the activity and enterprise of certain large estate proprietors.

As an illustration of this, we propose to give here some detailed account of one of the most interesting properties in the interior of the State, the "Fazenda de Funil", where, in combination with the employment of rational methods of cultivation, we find a usine fitted

up with the most modern apparatus and employing the most recent processes that have been introduced into the sugar cane manufacture of late years.

This estate, which belongs to Messrs. Nogueira & Co., is situated about 41 kilometres from Campinas, an important inland town with which it is connected by a metric gauge railway belonging to the State. The area of the estate comprises 8945 hectares, of which 700 are planted with canes of different varieties. Its favourable situation near the junction of two important rivers, the Zaguary and the Pirapitinguy, from whose strong current is obtained water power to the extent of over 3000 h.p., was the chief reason for replacing the old distillery which existed there till 1905 with a sugar factory of the most modern type, and electrically driven by means of a three-phase current.

The canes cultivated on this estate belong in the greater part to the Riscada or Striped variety, next come the canes of the Pretas (Lousier, Bois-Rouge) species and the Rose variety.

Planting takes place in general from September to April, and is carried out in the following manner. If virgin land is being prepared, it is first cleared of all the vegetation which covers it, the creepers and brushwood are burnt, and the trees cut down. Then the disintegration of the soil is commenced, and is carried out either by means of a plough or (in case the nature of the ground will not allow it) by means of an instrument called an *enxada*, which corresponds to the hoe of other lands. With this implement parallel furrows are formed about 20 cm. deep and 1·20 m. apart into which are laid pieces of cane cut to a length of 30 cm. and laid in one row at distances of 10 cm. apart. But if the land has already been under cultivation, a preliminary superficial clearing of the weeds growing thereon is all that is needed before spreading over the soil a certain quantity of manure or compost, the amount varying according to the nature and degree of exhaustion of the soil; this is turned in by means of a plough. The furrows are then formed and planting proceeds as above mentioned.

The canes thus planted require from ten to twenty days to sprout according to the nature of the season. When they have attained the height of about 20 cm., by which time the fourth leaf has appeared, a preliminary loosening of the soil with the aid of the *enxada* is carried out. As the cane grows this treatment is repeated, as a rule from four to six times according to the character of the soil.

Three months before maturity the canes are left to themselves, stripping not being practised in Brazil as in Hawaii and most other sugar countries.

As a rule if the season is good, there being no irrigation to fall back upon on this estate, the cane will take from 14 to 16 months to arrive

at maturity, according to its species and the situation. Cutting commences at the middle of June and terminates by November 15, at which time may be expected the tropical rains which put a stop to all outdoor work.

The second crop is prepared as follows. The new cane having been cut, the leaves and vegetation left on the ground are all set on fire. This practice, much criticised by some writers as involving a loss of nitrogen, is justified in Brazil as the canefields are infested with all sorts of insect pests which are in large part destroyed by this burning of the stubble.

As soon as the combustion is complete, the plough is passed along the old furrows as near to the roots of the canes as possible so that a part of these roots is cut off, this operation giving the plant fresh vigour and increasing its vegetation. A month later the first loosening is undertaken and is repeated thrice afterwards at regular intervals till the plant approaches maturity. This occurs at the end of 12 to 14 months, when the cane is ready to be cut. The third crop called the *Soca*, is prepared by the same methods.

The canes give an average of four to six crops, after that the roots are pulled up, the soil thoroughly worked up and then planted anew with fresh cane with the addition of manure.

The average yield of the cane thus grown varies, according to the season, the soil, and the species of the cane, from fifty to seventy tons per hectare for the first year, and forty to fifty tons for the subsequent ones. The saccharine content varies from 14 per cent. for *Lousier* or *Bois-rouge* to 16 per cent. for the Striped and Rose varieties.

The estate proprietors have experimented with certain varieties of green canes such as *Mastica*, *Salangore*, *Bamboo*, *Carlos*, *Botelho*, *Cayanna Rose*, &c., but it is to be feared that the dry and occasionally somewhat cold climate of the State of Sao Paulo will not allow them to attain full development, as they need plenty of heat and moisture.

The planting and the field work are almost entirely undertaken by settlers (*colons*), of whom there are nearly 800, mostly Italians, on this estate. Their condition is an extremely prosperous one, so much so that 50 new houses are at present under construction owing to the continuous arrival of new families, and one is not likely to be guilty of exaggeration if one concludes that before another year is past the number of workers on this estate will exceed 1000.

On their arrival, each family receives a free grant of a roomy house, pasturage for their cattle, free firewood, and timber for any shedding required. In addition, according to the number of hands he has available, each settler is given from 6 to 24 *quarteis* of canes to cultivate (4 *quarteis* equal 1 *aliquiere* which equals 24,200 square metres).*

* About 6 acres.

The settler receives his cane field ready planted, and then becomes responsible for its complete development. He is paid for this $60 per "quarteis" (156 fr. per hectare on the exchange rate of 635), which, supposing a mean yield of 50 tons to the hectare, represents for the proprietor an expenditure of 3·10 frs. per ton. Besides these settlers, there are the "empreiteiros" or contractors who on their arrival on the estate are allotted the same privileges as the settlers (free houses, pasturage, timber, &c.). They are supplied with rough land, which they till, plant with cane supplied free by the estate, attend to its cultivation, and when it is ripe cut it and load it on wagons, for which work they are paid the following sums per ton, according to the current price of a sack (60 kilos.) of white crystals on the Sao Paulo market:—

Price per sack of sugar (60 kilos.).	Price per ton of cane.
Not exceeding $18 (Fr. 28·30)	$7 (11 fr.)
From $18 to $24 (to Fr. 37·80)	$8 (Fr. 12·60)
,, $24 to $35 (to Fr. 55·10)	$10 (Fr. 15·70)
Above $35	$12 (Fr. 18·90)

As at present the price of this sugar is $36, each contractor thus receives $12 per ton on canes loaded.

Milling commences in general about the middle of June, a somewhat premature date it must be observed, but this is rendered necessary by the limited capacity of the usine for dealing with the amount of canes produced. During this period, every soul is occupied; the men are employed in various duties in the factory, while the women and children cut the canes in the fields The latter stripped of their leaves and tops are made up into *feixos* or bundles about 1·50 m. long containing ten canes. Each *feixo* weighs about 10 kilos, and for 100 *feixos* which represents the load of a cart about $2 (3·15 fr.) is paid. The carts drawn by four mules take the canes to the nearest railway truck where they are loaded into wagons and then sent up to the factory.

When, as is generally the case, the cane is provided by the settlers, the rates are settled by the factory staff and amount to about 500 reis (75 cents.) per ton.

The rolling stock comprises two 12-ton locomotives and 35 wagons of a capacity of 4300 kg. of cane. This stock is somewhat small for the requirements of the estate, and it is intended shortly to increase it by the addition of another 12-ton locomotive and ten iron wagons. The total extent of the track of which the gauge is 60 cm. (2 feet) is 12 kilometres, and it is well distributed over the cane areas.

The canes on arriving at the usine are weighed, and then discharged direct into the cane-cutters.

The Esther Usine is, as already mentioned, of recent formation. Built in 1905 to the designs of the Compagnie de Fives-Lille for an output of 120 tons or two hundred sacks of 60 kilos in 24 hours,

it treats the cane by direct diffusion. We do not propose to give here a detailed description of this establishment such as has already been described in a former number of the *Journal des Fabricants de Sucre*;* we merely propose to refer to one feature which distinguishes the procedure at this usine; the latter is the only sugar factory in Brazil which depends for its motive power exclusively on electricity.

For this purpose a conduit 2 kilometres long brings the water held up by a barrage across the Pirapitinguy, one of the rivers which bound the estate, to a large reservoir whence by means of a pipe one metre in diameter and 56 metres long having a fall of 18 metres, the water is delivered into a Voigt turbine coupled direct to an alternator of 300 H.P. The current produced is a three-phase one of 220 volts; it is conducted to the usine, situated a hundred metres away, and then by means of a distributing board is connected with the various motors employed. In its essential details, the Esther usine comprises: a cane cutter of 8 cm. capacity, working at 140 revolutions with a transmission pulley receiving its power from an electric motor of 8 H.P. and capable of dealing with 150 tons of chips of 0·002 m. thickness in two working hours. An inclined elevator and horizontal distributor driven by a 10 H.P. motor serving to raise and distribute the chips among the batteries. A battery of diffusers composed of 16 vessels of 22 hectolitres with a heating surface of 3 square metres each. A five-roller crushing mill, made by John McNeil & Co., Glasgow, which serves to dry the exhausted chips, and is driven by a vertical turbine of 15 H.P.

The juice coming from the diffusers is defecated in three double-bottom defecators of 17 hectolitres capacity, after which it is filtered by passing it through three Danêk sandfilters; the latter are open at the top and contain about 650 litres of sand, while the juice is filtered under a pressure of 20 cm. of liquid. The installation of these filters is an easy matter; their manipulation is likewise extremely simple, the washing of the sand being accomplished within the vessel itself by means of a steam injector having a pressure of about 5 lbs. On the whole we find in these filters the solution of a problem which has for long time troubled the cane sugar industry, viz., the complete and rapid filtration of the juice under conditions of simplicity and economy.

The evaporation of the juice is carried out in a triple effet of 1800 hectolitres capacity and 270† square metres of heating surface; it is however intended shortly to add a fourth vessel to the set. The syrups on passing out of the triple are sulphited in a Moret apparatus fitted with a vertical air compressor, then passed to the eliminators, of which there are three of 20 hectolitres capacity, after which they are filtered through three Danêk bag filters, each filter possessing 15 square metres of filtering surface.

*See also *I.S.J.*, June, 1907. † Or about 2900 square feet.

The vacuum pans are two in number, and of 90 and 60 hectolitres capacity respectively; and are used for the following purposes: the boiling to grain of the syrups of the first jet; the boiling to string of the runnings of the first and second jets. A central vacuum pumping apparatus serves both the triples and the vacuum pans; the barometric condenser is worked by a special centrifugal pump driven by a 7 H.P. motor. A portion of the hot condenser water is pumped by means of a 10 H.P. double centrifugal pump to the supply tank of the diffusers situated 11 metres above the floor of the diffusion batteries, thus allowing the diffusers to be fed with hot water and thereby achieving a considerable reduction in the fuel outlay.

The dry air pump attached to the condenser is driven by a belt geared down from a 20 H.P. motor. The different vertical pumps used for the juices, ammonia water, and syrups are all driven by transmission gearing coupled to an 8 H.P. motor.

The first jet masse-cuite on issuing from the pans is cooled in two open malaxeurs of 85 hectolitres capacity situated over the centrifugals. The latter are three in number, have baskets 1 metre in diameter, and are driven by a 3½ H.P. motor coupled direct to their vertical spindle, giving them a speed of 900 revolutions per minute. The output of these centrifugals is 300 sacks (of 60 kilos.) of white crystals per 24 working hours. Continuous lubrication is ensured by means of a small Broquet pump, also driven by an independent motor, which delivers the oil into a tank situated above the centrifugals.

The sugar after being centrifugalled falls into a helical conveyor, which transfers it to a dryer worked by a 5 H.P. motor, where it is rapidly cooled and dried. After that it is sacked.

Part of the crystal sugar is sold direct for consumption, while the remaining portion, which varies according to the demand, is ground to a fine powder and placed on the market under the name of "special sugar."

The centrifugal runnings are boiled to string and passed into two rectangular tanks of 65 hectolitres capacity, fitted with perforated pipes, and subjected to the action of compressed air supplied by a compresser driven by a belt giving 200 cubic metres of air per hour, and forcing the runnings under a pressure of 2 kg. into a receptacle called a *Regulator*. A portion of this air is afterwards used in the sulphur furnaces. This malaxage of the runnings takes 18 hours to complete, after which they are centrifugalled in ordinary belt-driven centrifugals. The molasses are sent to the distillery. All the power required for the apparatus of this process is supplied by one 20 H.P. motor.

The steam needed for heating up the juices and syrups, for diffusion, triple effets and vacuum pans, is furnished by two semi-tubular boilers of the Fives-Lille Co.'s design, each having 250 square metres of heating surface, and fitted with Godillot furnaces worked by a

5 H.P. motor. The fuel consists of the diffusion megass previously squeezed in the five roller mill already referred to, and dried to a water content of about 35% in a Huillard Drier which employs the heated gases escaping from the boiler furnaces. The exhaust ventilator fixed at the top of the Drier and serving to draw off these hot gases is driven by an 18 H.P. motor. The percentage of extra fuel used (represented by wood) amounts to 14% on the weight of the canes worked up.

There is attached to the usine a good laboratory, for the full chemical control of the work of the factory, and which undertakes all the cane and soil analyses that are needed to ensure a rational system of cultivation.

To sum up, the Esther Usine besides resorting entirely to electricity for its motive power possesses the following interesting features :— The diffusion process, drying of the megass by means of waste flue gases from the furnaces, sand filtration, malaxage of the runnings by means of compressed air, nearly all of which processes or apparatus are entirely new to Brazil.—(*Bulletin des Chimistes.*)

JAMAICA RUM.

In a recent issue of the *West Indian Bulletin* appears a paper on Jamaica Rum, read at the 1907 Agricultural Conference, by the Hon. H. H. Cousins, the Government Chemist of that Island. While it is unnecessary to reproduce it in full, we think some of the information it contains will be found of interest to our readers, and we therefore give below the chief points of interest.

There are three distinct classes of Jamaica Rum produced, each adapted for a particular market and each judged by a different standard of excellence. They are: (1) Rums for home consumption or "local trade quality"; (2) Rums for consumption in the United Kingdom or "home trade quality"; (3) Rums for consumption on the Continent or "export trade quality."

The first class or local trade quality is that consumed on the island. In amount it does not exceed three or four bottles per head per annum, and from the point of view of the revenue and the administration of government, Mr. Cousins regrets that the people are unable to afford the luxury of consuming three or four times as much. For rum is the wine of that colony so far as the lower orders are concerned, but the upper classes are showing an increasing preference for patent-still whiskey of Scotch origin. The high class trade in old rums of delicate softened flavour has largely disappeared and it would be difficult to procure any such spirit in Jamaica at the present day. The popular taste demands a light rum that will age or mature very rapidly. Such rums are the result of light settings and a quick fermentation. The stills are heated with steam coils and double retorts are used.

The ether content of these rums varies from a minimum of 90 parts per 100,000 volumes of alcohol to about 300 parts. The bulk of the spirit would average from 180 to 220 parts of ethers. These rums have a delicate pleasant aroma and when broken down with water yield a light type of residual flavour, inferior however to the rums of Class II.

The second class or home trade quality is sometimes alluded to as "public house rum" as it represents the class of rum which is required for the spirit trade in the United Kingdom under the name of "Jamaica Rum."

It was at one time considered that an analytical standard of ethers could be fixed whereby a genuine Jamaica rum could be differentiated from a patent-still colonial rum or a blended Jamaica rum. While, however, the best types of "home trade rums" contain 300 to 500 parts of ethers, and the great bulk of the rum exported from Jamaica is well above a standard of 200 parts of ethers, there are certain marks of rum (and among them some of stout body and attractive quality) which are as low as 100 parts of ethers. Except in cases of gross adulteration, therefore, purely analytical evidence is not of much avail in deciding whether a rum be a genuine Jamaica rum or not. A proposal to prohibit the exportation of any rums below a standard of 200 parts of ethers was seriously considered by the planters last year, but was thought to be unfair to individual estates, and eventually was abandoned.

These rums are generally produced by a slower type of fermentation than the local trade rums and some of the best marks are produced in ground cisterns and are slightly flavoured by the addition of some sour skimmings to the fermented materials. They are characterized by a high standard of heavy residual body, due in the main to ethers of acids of high molecular weight. These acids are not producible from sugars and are almost absent in rums other than Jamaican, which are produced from diluted molasses without dunder or acid skimmings and distilled in patent stills. Investigations indicate that these higher acids result from the bacterial decomposition of the dead yeasts found in the distillery materials in Jamaica, and it is evident that the adherent yeasts in the old ground cisterns have a great deal to do with the fine flavour of many of these home trade rums.

As the duty payable on rum in England is about eight times that of its value to the planter it is a most serious matter for the buyers at home if any fault should be found in the rum after it has been cleared from bond. Points that require attention are (1) cloudiness on dilution; (2) a burnt flavour; (3) excessive obscuration.

It has been found that the chief cause of cloudiness in Jamaica rums is due to high settings, and such an intensity of bacterial action that higher alcohols are produced in excess. The charge of wines in the retort being inadequate to fractionate these impurities, they enter

into the rum and cause cloudiness on dilution. To remedy this fault, insist on the distiller testing the spirit with water before accepting it as rum. All cloudy distillate should be set aside for high wines. The fermentation should then receive attention, and, if necessary, the vats should be lined to secure a clearer fermentation.

The burnt flavour too, is common in the case of fire-heated stills. It is frequently unnoticeable in the sample until it has been freely diluted with water. From the results obtained at Shrewsbury estate in Westmoreland, it is certain that all home trade rums could with advantage be distilled in stills heated by a steam coil. Burnt rum should then be unknown. The fetish of the "direct fire," that still lingers in the mind of Scotch whiskey distillers has no basis at all where Jamaica rum is concerned, since any excessive firing results in a most serious injury to the spirit produced.

As regards obscuration, there is now a demand for fully coloured rums (say No. 19 on Lovibond's scale) with an obscuration not exceeding $1\frac{1}{4}$ to $1\frac{1}{2}$ per cent. of proof spirit. This is readily attainable if care be taken in preparing the colour.

The third class or export trade quality supplies the market of the Continent. Thirty or forty years ago a trade in high class drinking rum was carried on with that market; but a Hamburg merchant who had in former days done a good trade in such choice brands of Jamaica drinking rums was recently bemoaning the fact that this trade had practically ceased since 1889 when the German Government raised the duty on Jamaican rums from a very low rate to the relatively high one of about 8s. per liquid gallon. From that time the entry into Germany of Jamaican rums suitable for direct consumption has been rendered almost impossible.

However the firm of Finke & Co., of Bremen and Kingston, and some enterprising planters on the north side of Jamaica, have succeeded in meeting this obstructive tariff by the development of a considerable trade in highly flavoured rums of such remarkable blending power that they could stand the high import duty and yet be utilized by the German blenders for producing a blended rum capable of competing with local distilled spirits subject to a merely nominal excise.*

These export rums are commonly known as German-flavoured rums in Jamaica, and are produced by a process that could only be adopted on a small estate with a relatively enormous distillery capacity. Instead of thirty hours' fermentation, as in the case of a Demerara or Trinidad rum, these German-flavoured rums demand a fermenting period of fifteen to twenty-one days.

*The *Wine and Spirit Trade Record* points out that some of these rums when mixed with plain spirit in the proportion of 1 to 5 will form a Jamaican rum which analysts cannot distinguish from the genuine article; and this journal pertinently asks how this can act to the ultimate advantage of the planters when it means the encouragement of methods which the Government of Jamaica have been so anxious to stop. The same view has been taken by the *West India Committee's Circular*,—(*Ed. I.S.J.*)

The yeasts at work are of the fission type entirely, and the whole process is operated under intensely acid conditions. It is remarkable that these fission yeasts should be able to attenuate a liquor with an acidity of 3 per cent., while the oval budding yeast may be paralyzed with an acidity of less than one-fifth of this amount.

These flavoured rums contain, as might be expected, a relatively high proportion of ethers. Some makes are as low as 600 or 700 parts of ethers, but are, as a rule, relatively rich in heavy-bodied ethers, and are possessed of great stretching power.

The finer qualities contain some 1000 to 1200 parts of ethers, and occasional samples may even attain a standard of 1500 or 1600 ethers. We have found that about 97 per cent. of these ethers are acetic ether, about 2 per cent. consist of butyric ether, traces of formic ether may be present, and from $\frac{1}{2}$ to $\frac{3}{4}$ per cent. of the total consists of heavy ethers derived from acids of high molecular weight.

It is upon this small trace of heavy ethers that the chief character, and, indeed, the commercial value of a high-flavoured rum depend.

As a rule the presence of high ethers is also associated with that of higher alcohols of a peculiar spicy and attractive fragrance.

Were these rums merely dependent on acetic and butyric ethers for their peculiar value, it is obvious that our trade would be at the mercy of any and every competitor.

The higher ethers, however, have such an intensity of aroma and flavouring power that they entirely dominate all other constituents; and the more we study the chemistry and the manufacture of German rums the more convinced do we become of the great difficulties in the way of reproducing them at will.

No two estates produce the same character of flavour. The differences are due to the variation in the bacterial flora, and these again are dominated by the differences in the composition of the material fermented, and the conditions under which it exists.

This manufacture is peculiarly precarious and erratic, both as to yields and to quality of produce. It is no unusual thing to find successive batches of rum from the same estate, apparently produced under identical conditions, varying in value from 8s. to 4s. per gallon. When the complicated process is studied, and the entire absence of all rational control is realized, it is only surprising that the results are not far less uniform than they are.

The trade in these rums puts a high premium on the judgment of the buyer, and the science of rum smelling is found in its highest refinement in the valuation of high-flavoured rums. To attain a high measure of efficiency, long training and experience are necessary. A delicate or highly sensitive nose is not so necessary as a faculty for the memory of smells. A good flavoured rum presents to the sense of smell a blend of various distinct types of smell in a proportion that is both attractive and satisfying to the trained nose.

BREEDING HYBRID SUGAR CANES.*

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(*Continued from page 51.*)

Experiments in Breeding Sugar Canes.

In cases that follow Mendel's Law the processes of plant breeding are definite and exact, viz., the characters existing in the parents are transferred in their full intensity to descendants of the hybrids, recessives breed true from the moment of their appearance, but only one-third of the individuals showing the dominant character breed true, and a further generation has to be raised before the pure dominants can be picked out. A number of examples have been noticed which do not behave along exactly similar lines. The characters may blend, giving an intermediate form, which may breed true or may give the parent forms among its offspring in the second generation. Other instances have occurred in which a totally new character has made its appearance which may or may not follow Mendel's Law, while whole series of new forms, apparently not combinations of visible parental characters, may appear.

The problem we have to face is this: Can the breeding of the sugar cane be conducted upon the same lines as the breeding of new varieties of peas or wheat? Is it possible, so to speak, to pick out the valuable characters from different varieties, and gradually build up an ideal type? This, of course, can only be shown by experiment, and consequently a series of experiments is being started in which definite crosses will be made with a view to ascertaining how the different characters desired are transmitted to the offspring. The sugar cane is built up af a series of characters, the inheritance of which must be traced independently of each other.

A thorough knowledge of the varieties to be experimented with is the first requisite, and then it is necessary to decide what characters are to be worked with. Only those varieties of sugar cane that have been tested under varying conditions of soil and climate have been chosen for experiment, for the securing of good parents is very important, as the number of varieties for experiment has to be limited. Only those characters which are of economic value, and which appeal to the planter, will be considered at the outset. It is hoped before long that definite results will be obtained, and that

* A paper read at the *West Indian Agricultural Conference, 1907.*

some knowledge will be gained of the different characters that will be considered in the experiments, viz., tonnage of cane per acre, richness of juice, and resistance to disease.

Tonnage Experiments.

For the tonnage experiments, six varieties, that have been under test for some time, have been chosen, viz., B. 1,753, B. 4,164, B. 4,028, B. 3,390, D. 95, and Queensland Creole. The first four have shown themselves to give a large tonnage per acre, while the last two are small tonnage canes. These varieties have been planted in four rows, twenty-five holes deep, and arranged according to a definite plan, so that any single variety can be crossed with any other. There will therefore be 100 holes of each variety. The rows run in the following order: B. 1,753, D. 95, B. 4,164, Queensland Creole, B. 4,028, B. 3,390, B. 4,164, B. 1,753, D. 95, B. 4,028, Queensland Creole, B. 3,390, B. 1,753, Queensland Creole, B. 4,164, B. 4,028, D. 95, B. 3,390, B. 1,753, B. 4,028, Queensland Creole, D. 95, B. 4,164, B. 3,390.

It will be possible, therefore, if the varieties arrow, to make the following crosses: Large tonnage crossed with large tonnage, large tonnage crossed with small tonnage, and small tonnage crossed with small tonnage. In this way it is hoped to ascertain whether tonnage of cane is a character that is transmitted to the offspring and whether certain varieties are of greater value in this respect than others.

It is expected that the sugar cane can be considerably improved in the direction of increased tonnage, especially when it is held that a larger tonnage of cane per acre depends largely upon increased vigour of the cane, for hybrids are generally more vigorous than their parents.

Juice Experiments.

Cousins, Jamaica, holds that "beyond a certain point—24 per cent. saccharose in the juice—any increase in richness involves a reduction in agricultural yield," but as only a few of the varieties now under experiment possess over 20 per cent. saccharose in the juice, maximum productiveness has not been obtained, and therefore experiments to inquire into the quantity of saccharose in the juice as a distinctive character of the sugar cane have been laid out on the same plan as the tonnage experiments. Six varieties, viz., B. 3,675, B. 208, B. 3,922, T. 24, B. 3,746, and B. 4,164 have been chosen for the experiments, the first four possessing rich juice and the last two poor juice. Each of the varieties has been planted in four rows—twenty-five holes deep—and arranged in the following order: B. 3,675, B. 3,746, B. 208, B. 4,164, B. 3,922, T. 24, B. 208, B. 3,675, B. 3,746, B. 3,922, B. 4,164, T. 24, B. 3,675, B. 4,164, B. 208,

B. 3,922, B. 3,746, T. 24, B. 3,675, B. 3,922, B. 4,164, B. 3,746, T. 24. These varieties have been laid out on a plan similar to that of the tonnage experiments and have been arranged so that different crosses can be made—rich-juice canes with rich-juice canes or with those having poor-juice, and the poor-juice canes among themselves.

Disease Experiments.

A similar plan of experiments has been laid out to inquire into the disease-resistant power of various varieties, as it is possible that increased vigour of a plot of canes as reflected in larger yield of sugar is accompanied by greater immunity from disease. The root disease is probably the one that, at the present time, is causing a considerable amount of damage in the West Indies. Large losses have certainly been incurred by this disease in Barbados, and therefore it is the one to which attention will be paid. Four varieties, viz., B. 6,048, B. 1,529, B. 3,289, and B. 208 have been chosen as those which are entirely immune or suffer little from the attacks of the fungus that causes this disease, and will be arranged with two others, B. 3,668 and B. 3,696 that appear to suffer severely from this cause.

These are planted on precisely the same plan as the tonnage and the juice experiments, in the following order:—B. 6,048, B. 3,668, B. 1,529, B. 3,696, B. 3,289, B. 208, B. 1,529, B. 6,048, B. 3,668, B. 3,289, B. 3,696, B. 208, B. 6,048, B. 3,696, B. 1,529, B. 3,289, B. 3,661, B. 208, B. 6,048, B. 3,289, B. 3,696, B. 3,668, B. 1,529, B. 208. The offspring of the crosses made will be tested for resistance against the root disease, and if sufficient disease is not present for tests from natural infection, artificial inoculations or injections will have to be resorted to.

Combination—Tonnage and Juice—Experiments.

The above three series of experiments have been established for the purpose of investigating different characters singly, but an effort will be made to examine closely a combination of two characters, with a view to obtaining definite knowledge as to the behaviour of these characters in several different varieties of sugar cane on hybridizing. Owing to the small space available for the conduction of these experiments and to the limited time during which it is possible to carry out the emasculation of the flowers, only twelve varieties have been chosen, and 100 holes of each variety set out. The canes are planted in chess-board fashion in rows twenty-five holes deep, and arranged so that any variety can be crossed with two others. The following varieties have been chosen:—B. 1,753, B. 3,289, B. 3,922, B. 6,048, B. 1,529, B. 4,769, B. 4,844, B. 4,164,

B. 208, B. 1,566, B. 3,390, B. 3,675. Table I. gives an outline of the crosses that it is proposed to make. An analysis of the characters of the different varieties chosen is also given, where R = rich juice, r = poor juice, T = large tonnage, and t = small tonnage.

Of course, it must be clearly understood that the different characters put forward in this table are not of the same value, for they vary slightly in different years, but they are held to be comparative. For example, B. 1,753 gave in 1903-5 an estimated yield of canes of 50·17 tons, while B. 3,289 only gave 42·34 tons; but these tonnage yields must be considered large against 28·92 tons of B. 1,529 and 29·88 tons of B. 4,844. The first are, therefore, designated by T. while the last are indicated by t. The same is the case with the juice of the different varieties.

TABLE I.

Combination—Juice and Tonnage—Experiments.

B. 1,753 (r T)	to be crossed with	B. 6,048 (R T) B. 1,566 (r T)
B. 3,289 (R T)	,, ,, ,,	B. 6,048 (R T) B. 3,675 (R t)
B. 3,922 (R t)	,, ,, ,,	B. 4,844 (r t) B. 1,529 (R t)
B. 6,048 (R T)	,, ,, ,,	B. 1,753 (r T) B. 3,289 (R T)
B. 1,529 (R t)	,, ,, ,,	B. 3,922 (R t) B. 4,164 (r T)
B. 4,769 (r t)	,, ,, ,,	B. 3,390 (R t) B. 4,844 (r t)
B. 4,844 (r t)	,, ,, ,,	B. 4,769 (r t) B. 3,922 (R t)
B. 4,164 (r T)	,, ,, ,,	B. 3,390 (R t) B. 1,529 (R t)
B. 208 (R t)	,, ,, ,,	B. 3,675 (R t) B. 1,566 (r T)
B. 1,566 (r T)	,, ,, ,,	B. 208 (R t) B. 1,753 (r T)
B. 3,390 (R t)	,, ,, ,,	B. 4,164 (r T) B. 4,769 (r t)
B. 3,675 (R t)	,, ,, ,,	B. 3,289 (R T) B. 208 (R t)

The planting of the varieties in chess-board fashion has been practised in order to make crossing as easy as possible, and the following table illustrates the arrangement adopted:—

TABLE II.

Chess-board Planting taken from the Combination—Juice and Tonnage—Experiments.

B. 1,753	B. 6,048	B. 1,753	B. 6,048	B. 1,753	B. 1,566	B. 1,753	B. 1,566
x	x	x	x	x	x	x	x
B. 6,048	B. 1,753	B. 6,048	B. 1,753	B. 1,566	B. 1,753	B. 1,566	B. 1,753
x	x	x	x	x	x	x	x
B. 1,753	B. 6,028	B. 1,753	B. 6,048	B. 1,753	B. 1,566	B. 1,753	B. 1,566
x	x	x	x	x	x	x	x
B. 6,048	B. 1,753	B. 6,048	B. 1,753	B. 1,566	B 1,753	B. 1,566	B. 1,753
x	x	x	x	x	x	x	x

Continued to twenty-five holes deep.

The varieties have all been carefully studied, and have been chosen as being the best we have on hand at the present. Careful systematic work, conducted along definite lines, is to be carried out in order to analyse the different qualities of the sugar cane and to incorporate as many of the best characteristics as can possibly be brought together in a single variety in order to fulfil a certain and definite purpose. Arrows of the various varieties will also be bagged separately to obtain self-fertilised seedlings, in order to investigate, if possible, the dominant characteristics more fully, for it is suspected that some, if not many, of the varieties chosen may be impure or hybrid types. This will considerably complicate matters, but difficulties will have to be met.

Small numbers of seedlings can only be obtained owing to mechanical difficulties in emasculation and cross-pollination, on account of the small size of the flowers and the height of the arrows above the ground, to the varied time of arrowing and often to a total lack of arrows, as well as to unfavourable climatic conditions. It is hoped, however, that in a few years canes will be built up, character by character, that will stand the rigorous test of field selections and analyses in the laboratory.

A systematic investigation of the material on hand, in order that something definite may be learned about the unit characters with which we intend to deal, their dominance, and their combination and correlation with other characters, is to be undertaken. With this fundamental work accomplished, it may be possible to deal with varieties concerning whose characteristics something definite is known, and to prosecute the work of sugar cane breeding in definite directions and to secure results previously planned for.

Other Experiments for Producing Hybrids.

The difficulties of obtaining large numbers of hybrids by hybridization under control have been mentioned previously, and as the access of pollen from an unknown source must be recognised as being detrimental to advancement in hybridization work, and as it would lead to entirely erroneous conclusions, a series of experiments by which it is hoped to obtain hybrids by what may be called natural hybridization has been started.

It has been well known for some time that certain varieties of the sugar cane produce much fertile pollen while the pistil is normal, and others produce little or none. Advantage of this fact has been taken by the experimentalists in Java, and large numbers of hybrids have been obtained by planting in alternate rows varieties that arrow at the same time, one of which may be called "male," possessing much fertile pollen, and the other "female," possessing a very small proportion of fertile pollen. The arrows from the "female" variety alone are cut, and the resulting seedlings must be the result of a cross or of self-fertilization, and the chances, under Java conditions, are such that the "male" variety planted in the adjoining rows is generally held to have provided the pollen.

With the high winds that prevail in the West Indies it is thought that such a method cannot be satisfactorily practised, but it is hoped that, if varieties "male" and "female"—be planted in chess-board fashion and an arrow producing much normal pollen be bagged with an arrow producing little fertile pollen at an early stage, before outside pollen from an unknown source can be blown upon the stigmatic plumes of the "female" variety, a number of seedlings can be obtained of known parentage. After a sufficient time has elapsed for pollination the "male" arrow would be taken out and only the "female" arrow sown.

It is possible that some seedlings would be the result of self-fertilization, as sometimes the "female" canes produce a few normal pollen grains; but in these varieties the chances of self-fertilization are reduced to a minimum and, therefore, if fertile seeds are produced by these canes they will almost certainly be the result of hybridization. By this method, access of pollen from an unknown source cannot take place, and the risk of obtaining large numbers of seedlings of less value than the female parent will be largely reduced.

At the Dodds Experiment Station, Barbados, plots have been laid out to test this method. Canes that have stood the stringent test for a number of years have been selected. B. 376 has been planted chess-board fashion with B. 208, and White Transparent is to be crossed with B. 3,289; 2½ acres have been planted in all. White Transparent and B. 376 produce little fertile pollen, and therefore, any

seedlings obtained from them should be the result of crossing, and an advance made in the desired direction.

It is hoped that this method may give results that would justify its adoption on a larger scale, and be the practical method of gradually improving the sugar cane along scientific lines.

Conclusion.

In conclusion, it will be seen that definite plans have been laid out by the Department for the breeding of hybrid sugar canes, as it is expected that considerable improvement can be made. The experiments have been started on a small scale, as it is necessary to become as fully acquainted as possible with the characters of different chosen varieties, in order that the inherent tendencies for utility may be understood, and so that the life forces of the best varieties may be directed into useful channels. Records of pedigrees, relative values of hybrids, dominance of characters, &c., will have to be kept and arranged in such a way that the value of any individual may be seen at a glance. It is possible that, in hybridization, totally new characters may make their appearance which may prove of value and possibly different characters of the parents may show blending, but until experimental evidence is obtained nothing can be said of what results will follow. Several years must elapse before sufficient varieties have been raised and submitted to rigorous field and laboratory tests, before recommendations can be made to the planters. Plant breeding has been put upon a definite basis, for it has been shown that, with the proper understanding of the inheritance of the unit characters, new varieties can be built up with certainty, by picking out and combining together characters already existing in other varieties. Improvements can be made by picking out a desirable feature here, another there, and combining them together. It is expected that hybridization will be the means of making rapid improvement in the sugar cane, and it is hoped that among the hybrids there will be some that will not be found wanting when the final tests are made.—(*West Indian Bulletin.*)

CONSULAR REPORTS.

Holland.

Amsterdam.—Owing to high prices at the beginning of 1906 beetroot was more extensively cultivated in the Netherlands for the production of sugar. The production of beetroot sugar in this country amounted to 190,000 tons.

The Java harvest was the largest ever recorded. The 1906-07 crop amounted to 750,000 tons.

Prices of beetroot sugar at Amsterdam per 100 kilos. :—

	Highest. Florins.		Lowest. Florins.
1902	10	....	7·50
1903	10·50	....	9·50
1904	18	....	9·50
1905	19·25	....	9·75
1906	12·50	....	9·75

Average in 1906, 11 c. per kilo.; retail price, 55 c. There is no import duty on sugar, but an excise tax of 27 c. per kilo.

Imports of sugar:—

	Netherlands. Tons.	Amsterdam. Tons.	Remarks. Tons.
Raw beet.. ..	117,570	38,544	65,000 from Germany.
,, cane.. ..	7,800	2,635	
Other sorts ..	72,951	6,039	47,000 from Germany.
Total.. ..	198,321	47,218	

Exports of sugar:—

	Netherlands. Tons.	Amsterdam. Tons.	Remarks.
Treacle, &c. ..	22,104	6,472	Bulk to Germany.
Raw beet	110,177	3,519	67,000 tons to Germany 39,000 tons to United Kingdom.
Raw cane.. ..	4,121	1,157	
Other sorts ..	189,558	124,096	134,000 tons to United Kingdom, 51,000 tons to Germany.
Total.. ..	325,960	135,244	

Ecuador.

Ecuador sugar has been put on the market in the year 1906 in even greater quantities than in the preceding ones; but it is satisfactory to notice that not only has it been found unnecessary to export any part of the product, but that even the full increased production has been consumed in the country, and an import of 1,200 tons has been required to complete the supply for national consumption. The figures for the last three years are as follows:—

	Quintals.		Tons.
1904	141,422	....	6,400
1905	127,148	....	5,900
1906	153,800	....	6,900

Note.—Exported 12,174 quintals or 540 tons.

In the year 1907 there has also been an import (induced by the decree freeing sugar from all import duties) of 26,500 quintals, or nearly 1,200 tons, which, as stated above, has also been fully consumed in the country.

Mr. W. B. Thomas has been appointed President of the American Sugar Refining Company in the place of the late H. O. Havemeyer.

WEEKLY STATEMENT OF COMPARATIVE

For the Fifty-two weeks of 1907 compared

	German Beetroot 88 o/o Prompt, free on board.						French Crystals. No. 3. c. f. i.			Java afloat. No. 15 and 16.		
	1907.		1906.		1905.		1907.	1906.	1905.	1907.	1906.	1905.
Jan. 4..	8/10	8/8½	8/1½	8/2¼	14/5	15/1½	Nom.	10/2¼	--	10/7½	9/1½	15/10½
11..	8/8½	8/11¼	8/2¼	8/3	15/1½	15/11¾	,,	10/2¼	—	10/1½	9/3	16/10½
18..	8/11¼	8/9¾	8/3	8/2½	15/11¾	16/0¾	,,	10/3	—	10/1½	9/1½	17/3
25..	8/9¾	8/9¼	8/2½	8/2	16/0¾	16/-	,,	10/2¼	—	10/1½	9/1½	17/1½
Feb. 1..	8/9¼	8/8¼	8/2	7/11½	16/-	15/6½	10/8¼	10/-	—	10/1½	9/-	16/10½
8..	8/8¼	8/9¼	7/11½	8/-	15/6½	15/2	10/9	10/0¾	—	10/1½	9/-	16/7½
15..	8/9¼	8/10	8/-	8/0½	15/2	15/1½	10/9	10/1½	—	10/1½	9/-	16/-
22..	8/10	9/-	8/0½	8/2	15/1½	15/4½	10/9	10/3	—	10/-	9/1½	16/-
March 1.	9/-	8/11¼	8/2	8/3	15/4½	15/3¼	10/9¾	10/5¼	17/-	10/-	9/1½	16/-
8..	8/11¼	9/1½	8/3	8/3¾	15/3¼	15/-	10/10½	10/6	16/9	10/1½	9/1½	15/10½
15..	9/1½	8/11¾	8/3¾	8/5	15/-	14/7¾	10/9¾	10/7½	16/6	10/3	9/3	15/7½
22..	8/11¾	9/2½	8/5	8/4½	14/7¾	14/5¼	10/10½	10/9	16/6	10/3	9/6	15/4½
29..	9/2¼	9/3¼	8/4½	8/4¼	14/5¼	14/6½	11/-	10/6¾	16/6	10/3	9/6	15/3
April 5..	9/3¼	9/2	8/4¼	8/5¼	14/6½	14/5¼	10/10½	10/9	16/6	10/3	9/6	15/3
12..	9/2	9/3½	8/5¼	8/6	14/5¼	14/0¼	11/-	10/10½	16/6	10/4½	9/6	15/4½
19..	9/3½	9/5	8/6	8/4¾	14/0¼	13/1¼	11/-	10/9	16/6	10/4½	9/4½	14/10½
26..	9/5	9/5¼	8/4¾	8/4¼	13/1½	12/9¾	11/1½	10/9	Nom.	10/4½	9/4½	14/6
May 3..	9/5¼	9/7¼	8/4¼	8/2¾	12/9¾	12/1½	11/4½	10/7½	Nom.	10/6	9/3	14/6
10..	9/7¼	10/1	8/2¾	8/1½	12/1½	11/10	11/9¾	10/7½	Nom.	10/9	9/2¼	13/9
17..	10/1	9/11¼	8/1½	7/11	11/10¼	11/8¼	11/6¾	10/4½	Nom.	10/9	9/0¾	13/6
24..	9/11¼	9/11¾	7/11	7/10¾	11/8	11/11½	11/6	10/3	Nom.	10/9	8/11¼	13/6
31..	9/11¾	9/11¾	7/10¾	8/-	11/11½	11/9¾	11/6	10/6	Nom.	10/9	8/11¼	13/3
June 7..	9/11¾	9/11	8/-	8/0½	11/9¾	11/11½	11/6	10/6	Nom.	10/10½	9/-	13/3
14..	9/11	9/9½	8/0½	8/3	11/11½	11/9¾	11/1½	10/8¼	Nom.	10/10½	9/3	13/3
21..	9/9½	9/8¼	8/3	8/2	11/9¾	11/9½	11/1½	10/6	Nom.	10/10½	9/4½	13/1½
28..	9/8¼	9/8¼	8/2	8/2¾	11/9½	10/11¼	11/3¾	10/6¾	Nom.	10/9	9/6	12/10½
July 5..	9/8¼	9/6½	8/2¾	8/5	10/11¼	10/6	11/1½	10/9¾	Nom.	10/9	9/6	12/9
12..	9/6¼	9/5¼	8/5	8/4¼	10/6	10/2½	11/0¼	10/8¼	Nom.	10/4½	9/6	11/9
19..	9/5¼	9/9	8/4¼	8/6	10/2½	10/11½	11/3¾	10/9	Nom.	10/6	9/6	11/9
26..	9/9	9/8¾	8/6	8/7	10/11¼	11/-	11/3¾	10/9¾	Nom.	10/7½	9/7½	11/9
Aug. 2..	9/8¾	9/9½	8/7	8/9½	11/-	10/6	11/4½	11/-	Nom.	10/7½	9/9	11/6
9..	9/9½	9/9	8/9½	8/11½	10/6	10/1½	11/4½	11/1½	Nom.	10/7½	10/-	11/6
16..	9/9	9/9	8/11½	9/0½	10/0½	9/5	11/4½	11/1½	Nom.	10/7½	10/-	11/6
23..	9/9	10/0½	9/0½	9/5½	9/5	9/1½	11/9	11/3	11/3	10/9	10/1½	11/-
30..	10/0½	9/11½	9/5½	9/5	9/1½	8/9	11/9	11/5¼	10/7½	10/10½	10/3	10/3
Sept. 6..	9/11½	10/2½	9/5	9/6¾	8/9	8/7	12/0¾	11/6¾	10/7½	11/1½	10/4½	10/3
13..	10/2½	9/11½	9/6¾	10/2	8/7	8/5½	11/9¾	12/-	10/5¼	11/1½	10/9	10/0
20..	9/11½	9/11	10/2	9/7½	8/5½	8/8	11/10½	11/10½	10/6¾	11/1½	10/10½	9/9
27..	9/11	9/10	9/7½	9/9	8/8	8/7½	11/8½	11/10½	10/7½	11/1½	11/-	9/9
Oct. 4..	9/10	9/8¾	9/9	9/3½	8/7½	8/9½	11/7½	11/10½	10/6	11/1½	10/10½	9/9
11..	9/8¾	9/5¼	9/9	9/5¼	8/9½	8/8¼	11/6	11/7½	10/6	10/10½	10/10½	9/7½
18..	9/5¼	9/4	9/5¼	9/4¼	8/8¼	8/4¼	11/4½	11/7½	10/0¾	10/7½	10/10½	9/7½
25..	9/4	9/3¾	9/4¼	8/11	8/4¼	8/3	11/3¾	11/3	10/-	10/7½	10/9	9/1½
Nov. 1..	9/3¾	9/3½	8/11	8/7	8/3	8/0¼	11/3	11/-	9/7½	10/7½	10/4½	9/-
8..	9/3½	9/3½	8/7	8/9¼	8/0¼	8/0½	11/3	11/3	9/8¼	10/4½	10/7½	9/-
15..	9/3½	9/4½	8/9¼	8/9½	8/0½	8/2½	11/4½	11/3	10/-	10/4½	10/6	9/-
22..	9/4½	9/3¾	8/9½	8/9½	8/2½	8/5¼	11/3¾	11/3	10/4½	10/4¼	10/4½	9/3
29..	9/3¼	9/4	8/9½	9/0½	8/5¼	8/3	11/3¾	11/3	10/-	10/4½	10/4½	9/3
Dec. 6..	9/4	9/6¾	9/0½	9/1	8/3	8/3½	Nom.	Nom.	10/3	10/4½	10/4½	9/3
13..	9/6¾	9/8	9/1	8/8¾	8/3½	8/2	,,	,,	10/0¾	10/6	10/4½	9/3
20..	9/8	9/9	8/8¾	8/11	8/2	8/1½	,,	,,	10/0¾	10/7½	10/4½	9/3
27..	9/9	9/11½	8/11	8/10	8/1½	8/1½	,,	,,	10/-	10/7½	10/4½	9/1½

PRICES OF RAW AND REFINED SUGAR,

with those of the two previous years.

	Tate's Cubes. No. 1.			Tate's Cubes. No. 2.			First Marks German Granulated f. o. b.			Say's Cubes f. o. b.			German & Austrian † Cubes f. o. b.		
	1907.	1906.	1905.	1907.	1906.	1905.	1907.	1906.	1905.	1907.	1906.	1905.	1907.	1906.	1905.
Jan. 4..	18/10½	18/7½	24/7½	17/10½	17/10½	22/10½	10/6	10/1½	16/7½	13/-	12/6	19/6	12/6	11/10½	18/7½
11..	18/10½	18/7½	25/7½	17/10½	17/10½	24/10½	10/7½	10/3	17/6¾	13/-	12/6	20/-	12/6	11/10½	19/6
18..	18/10½	18/4½	25/10½	17/10½	17/7½	25/1½	10/7½	10/3	17/9¾	13/-	12/6	20/-	12/4½	11/9	19/7½
25..	18/10½	18/4½	25/10½	17/10½	17/7½	25/1½	10/6¾	10/2¼	17/9	13/-	12/3	20/3	12/4½	11/7½	19/6
Feb. 1..	18/9	18/4½	25/10½	17/9	17/7½	25/1½	10/4½	10/-	17/5¼	13/-	12/3	20/3	12/3	11/7½	19/6
8..	18/9	18/1½	25/7½	17/9	17/4½	24/10½	10/6	10/0¾	16/11¼	13/-	12/3	20/-	12/4½	11/7½	19/6
15..	18/9	18/1½	25/1½	17/9	17/4½	24/4½	10/9¾	10/0¾	16/10½	12/6	12/3	20/-	12/4½	11/7½	19/3
22..	18/9	18/1½	25/1½	17/10½	17/4½	24/4½	10/10½	10/3	17/1½	12/7½	12/3	19/6	12/5¼	11/9	19/3
March 1..	18/9	18/4½	25/-	17/10½	17/6	24/3	10/6¾	10/3¾	16/10½	12/7½	12/3	19/6	12/5¼	11/10½	19/3
8..	19/-	18/6	25/-	18/-	17/7½	24/3	10/9	10/3	16/6	12/9	12/6	19/-	12/6	11/10½	19/3
15..	19/-	18/7½	24/9	18/-	17/9	24/-	10/8¼	10/5¼	16/4½	12/6	12/9	18/9	12/6	12/-	19/-
22..	19/1½	18/9	24/6	18/1½	17/10½	23/9	10/9	10/6	16/1½	12/7½	12/9	18/9	13/6¾	12/1½	18/7½
29..	19/3	18/9	24/6	18/3	17/9	23/9	11/-	10/5¼	16/3	12/7½	12/6	18/9	12/7½	12/1½	18/6
April 5..	19/3	18/9	24/6	18/3	17/9	23/9	10/9¾	10/6	16/3	12/7½	12/6	18/9	12/7½	12/3	18/6
12..	19/3	18/9	24/6	18/3	17/10½	23/9	11/-	10/9	15/10½	12/7½	12/6	18/9	12/7½	12/3	18/6
19..	19/4½	18/9	24/-	18/4½	17/10½	23/3	11/0¾	10/7½	15/1½	12/9	12/6	18/9	12/9	12/3	18/6
26..	19/4½	18/7½	23/6	18/6	17/7½	22/9	11/1½	10/6¾	14/9	13/-	12/6	18/-	12/11¼	12/-	17/6
May 3..	19/7½	18/4½	23/3	18/7½	17/4½	22/6	11/3¾	10/5¼	14/3¾	13/3	12/6	18/-	13/2¼	12/-	17/-
10..	20/-	18/4½	22/9	19/-	17/4½	22/-	11/8¼	10/3¾	13/10½	13/9	12/6	17/-	13/9	11/10	16/6
17..	20/1½	18/4½	22/-	19/1½	17/4½	21/3	11/6¾	10/3	13/6	13/9	12/6	16/6	13/7½	11/9	16/-
24..	20/1½	18/1½	22/4½	19/1½	17/1½	21/7½	11/6	10/2¼	14/-	13/9	12/6	16/6	13/7½	11/7½	16/1½
31..	20/-	18/1½	22/4½	19/-	17/1½	21/7½	11/6	10/3¾	13/11¼	13/9	12/6	16/6	13/6	11/7½	16/1½
June 7..	19/10½	18/1½	22/7½	18/10½	17/1½	21/10½	11/5¼	10/4½	14/2¼	13/9	12/6	16/6	13/9	11/7½	16/3
14..	19/7½	18/4½	22/7½	18/7½	17/4½	21/10½	11/3	10/7½	14/0¾	13/7½	12/6	16/6	13/7½	11/10½	16/1½
21..	19/7½	18/4½	22/4½	18/7½	17/4½	21/7½	11/3	10/5¼	14/0¾	13/6	12/6	16/3	13/4½	11/10½	16/-
28..	19/9	18/6	21/10½	18/9	17/6	21/1½	11/3¾	10/5¼	13/3	13/3	12/6	16/3	13/4½	11/7½	15/6
July 5..	19/9	18/6	21/4½	18/9	17/6	20/7½	11/2¼	10/7½	12/9	13/4½	12/9	16/3	13/4½	11/10½	15/6
12..	19/7½	18/6	21/4½	18/7½	17/6	20/7½	11/0¾	10/5¼	12/-	13/4½	12/9	15/9	13/4½	11/10½	15/3
19..	19/9	18/7½	21/7½	18/9	17/7½	20/10½	11/3¾	10/7½	12/10½	13/7½	12/9	15/9	13/6	11/10½	15/3
26..	19/9	18/9	21/7½	18/10½	17/9	20/10½	11/3¾	10/8¼	12/10½	13/7½	13/-	15/9	13/6	12/-	15/3
Aug. 2..	19/9	19/-	21/4½	18/10½	18/-	20/7½	11/4½	11/-	12/7½	13/7½	13/-	15/9	13/8¼	12/1½	14/10½
19..	19/10½	19/3	21/4½	19/-	18/3	20/7½	11/4½	11/2¼	12/6¾	13/10½	13/3	15/-	13/9	12/3	14/10½
16..	19/10½	19/1½	21/1½	19/-	18/1½	20/4½	11/4½	11/2¼	12/0¾	13/10½	13/3	15/-	13/9	12/3	14/7½
23..	20/-	19/-	20/4½	19/3	18/-	19/7½	11/9	11/7½	11/8¼	14/1½	13/6	14/6	14/-	12/6	14/3
30..	20/1½	19/1½	19/10½	19/4½	18/1½	19/1½	11/9	11/6	11/4½	14/1½	13/9	14/3	14/1½	12/9	14/-
Sept. 6..	20/3	19/4½	19/10½	19/6	18/4½	19/1½	12/0	11/8¼	11/3	14/3	13/9	14/3	14/4½	13/-	14/-
13..	20/1½	20/-	19/10½	19/4½	19/-	19/1½	11/9	12/2¼	11/1½	14/6	14/3	14/3	14/4½	13/6	13/6
20..	20/1½	19/10½	19/10½	19/4½	18/10½	19/1½	11/8¼	11/9¾	12/1½	14/9	14/6	14/3	14/3	13/1½	13/3
27..	20/3	19/10½	19/10½	19/6	18/10½	19/1½	11/8¼	11/11¼	11/9	14/3	14/6	13/9	14/1½	13/1½	13/6
Oct. 4..	20/3	19/7½	19/10½	19/6	18/7½	19/1½	11/7½	11/6	11/4½	14/-	14/6	13/9	13/9	12/10½	13/6
11..	20/1½	19/4½	19/10½	19/4½	18/4½	19/1½	11/8¼	11/5¼	10/10½	13/9	14/6	13/9	13/3	12/10½	13/6
18..	19/7½	19/6	19/10½	18/10½	18/6	19/1½	11/6	11/5¼	10/3	13/9	14/-	13/9	13/-	12/10½	12/9
25..	19/7½	19/-	19/4½	18/7½	18/-	18/7½	11/1½	10/9¾	10/2¼	13/6	14/-	13/6	13/-	12/7½	12/9
Nov. 1..	19/7½	18/9	19/1½	18/7½	17/9	18/4½	11/0¾	10/4½	9/9¾	13/6	13/9	13/-	13/-	12/4½	12/-
8..	19/6	18/9	19/1½	18/6	17/9	18/4½	11/0¾	10/6	9/9¾	13/6	13/9	12/6	13/-	12/6	12/-
15..	19/6	18/10½	18/7½	18/6	17/10½	17/10½	11/1½	10/5¼	9/11¼	13/6	13/6	12/6	13/3	12/6	11/9
22..	19/6	18/9	18/10½	18/6	17/9	18/1½	10/11¼	10/6	10/4½	13/9	13/3	13/-	13/3	12/4½	12/3
29..	19/6	18/9	18/10½	18/6	17/9	18/1½	10/11¼	10/9	10/1½	13/9	13/3	13/-	13/3	12/7½	12/3
Dec. 6..	19/7½	19/-	18/10½	18/9	18/-	18/1½	11/0¾	10/9	10/1½	14/-	13/3	12/9	13/3	12/7½	12/-
13..	19/7½	18/9	18/10½	18/9	17/9	18/1½	11/2¼	10/5¼	10/0¾	14/3	13/-	12/9	13/4½	12/6	12/-
20..	19/7½	18/9	18/7½	18/9	17/9	17/10½	11/3¾	10/6¾	10/-	14/3	13/-	12/9	13/4½	12/9	11/9
27..	19/10½	18/10½	18/7½	19/-	17/10½	17/10½	11/6¾	10/8¼	9/11¼	14/3	13/-	12/6	13/6	12/9	11/10½

† Basis average Hansa FKL FMS.

H. H. Hancock & Co., 39, Mincing Lane, London, E.C.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM

To end of December, 1906 and 1907.

IMPORTS.

Raw Sugars.	Quantities. 1906. Cwts.	Quantities. 1907. Cwts.	Values. 1906. £	Values. 1907. £
Germany	8,817,201	7,980,826	3,862,316	3,838,885
Holland	522,895	606,027	245,136	309,582
Belgium	1,259,187	620,298	571,338	296,758
France	250,782	442,014	110,737	229,884
Austria-Hungary	242,584	423,640	100,692	196,163
Java	357,813	1,177,541	174,522	619,823
Philippine Islands	....	229,820	....	96,287
Cuba	111,885	91,113	41,943	39,600
Peru	537,832	514,821	243,681	252,943
Brazil	997,255	192,165	391,941	79,525
Argentine Republic	....	....	....	....
Mauritius	126,741	529,100	48,362	218,913
British East Indies	146,713	116,135	60,570	50,517
Straits Settlements	104,409	214,035	41,720	88,554
Br. W. Indies, Guiana, &c.	1,588,328	1,259,351	851,503	742,463
Other Countries	194,261	534,956	90,422	264,295
Total Raw Sugars	15,257,886	14,931,842	6,834,883	7,324,192
Refined Sugars.				
Germany	12,457,939	13,221,501	7,135,446	7,851,911
Holland	2,829,872	2,631,085	1,719,342	1,679,532
Belgium	553,537	649,900	324,822	392,323
France	2,249,894	3,216,128	1,278,142	1,892,298
Other Countries	4,921	2,812	2,905	1,969
Total Refined Sugars	18,096,163	19,721,426	10,460,657	11,819,033
Molasses	2,656,469	2,825,522	517,621	554,432
Total Imports	36,010,518	37,478,790	17,813,161	19,697,657

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	377	292	257	220
Norway	17,396	15,064	10,373	9,235
Denmark	94,582	91,061	47,929	50,192
Holland	80,410	69,464	49,831	46,895
Belgium	11,127	9,450	6,520	5,846
Portugal, Azores, &c.	30,626	15,850	16,728	9,015
Italy	34,196	26,646	17,274	14,757
Other Countries	628,651	445,879	412,778	332,276
	897,365	673,706	561,690	468,436
Foreign & Colonial Sugars				
Refined and Candy	32,996	32,972	20,939	22,373
Unrefined	162,457	70,224	83,395	41,780
Molasses	6,322	4,293	1,979	1,327
Total Exports	1,099,140	781,195	668,003	533,916

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1908. Tons.		1907. Tons.
Total Receipts January 1st to 16th ..	31,582	..	66,700
Receipts of Refined ,, ,, ...	....	..	....
Deliveries ,, ,, ...	37,202	..	61,257
Consumption (4 Ports, Exports deducted) since January 1st..	....	..	....
Importers' Stocks, January 15th	none	..	5,443
Total Stocks, January 22nd	82,000	..	144,240
Stocks in Cuba, ,, ...	27,000	..	102,000
	1907.		1906.
Total Consumption for twelve months..	2,993,979	..	2,864,013

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1906 AND 1907.

(Tons of 2,240lbs.)	1905-6. Tons.		1906-7. Tons.
Exports	1,150,466	..	1,345,787
Stocks	903	..	24,415
	1,151,369	..	1,370,202
Local Consumption (12 months)	46,830	..	57,471
	1,198,199	..	1,427,673
Stock on 1st January (old crop)	19,450	..	——
Total Production	1,178,749	..	1,427,673

Havana, November 30th, 1907. J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR TWELVE MONTHS ENDING DECEMBER 31ST, 1907.

SUGAR.	Imports. 1905. Tons.	Imports. 1906. Tons.	Imports. 1907. Tons.	Exports (Foreign). 1905. Tons.	Exports (Foreign). 1906. Tons.	Exports (Foreign). 1907. Tons.
Refined	734,790	904,808	986,071	1,189	1,650	1,649
Raw	732,832	762,894	746,592	5,676	8,123	3,511
Molasses	126,900	132,823	141,276	145	316	215
Total..........	1,594,522	1,800,525	1,873,939	7,010	10,089	5,375

	Home Consumption. 1905. Tons.	Home Consumption. 1906. Tons.	Home Consumption. 1907. Tons.
Refined..	731,774	874,650	960,248
Refined (in Bond) in the United Kingdom	552,097	539,800	502,757
Raw	101,599	144,809	117,195
Molasses	124,058	128,483	134,100
Molasses, manufactured (in Bond) in U.K.	57,444	62,476	62,566
Total..............................	1,566,972	1,720,218	1,776,866
Less Exports of British Refined....................	32,369	44,868	33,685
Total Home Consumption of Sugar	1,534,603	1,675,350	1,743,181

Stocks of Sugar in Europe at uneven dates, Jan. 1st to 18th, compared with previous Years.

In thousands of tons, to the nearest thousand.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	Total 1908.
173	1398	674	984	253	3482

	1907.	1906.	1905.	1904.
Totals	3506 ..	3856 ..	2737 ..	3614

Twelve Months' Consumption of Sugar in Europe for Three Years, ending December 31st, in thousands of tons.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria-Hungary	Holland, Belgium, &c.	Total 1907.	Total 1906.	Total 1905.
1895	1163	660	532	204	4454	4420	3798

Estimated Crop of Beetroot Sugar on the Continent of Europe for the current Campaign, compared with the actual crop of the three previous Campaigns.

(From Licht's Monthly Circular.)

	1907-1908. Tons.	1906-1907. Tons.	1905-1906. Tons.	1904-1905. Tons.
Germany	2,132,000 ..	2,238,000 ..	2,415,136 ..	1,598,164
Austria	1,460,000 ..	1,344,000 ..	1,509,870 ..	889,373
France	725,000 ..	756,000 ..	1,089,684 ..	622,422
Russia	1,410,000 ..	1,470,000 ..	968,000 ..	953,626
Belgium	235,000 ..	283,000 ..	328,770 ..	176,466
Holland	175,000 ..	181,000 ..	207,189 ..	136,55
Other Countries .	435,000 ..	445,000 ..	415,000 ..	332,098
	6,572,000	6,717,000	6,933,649	4,708,587

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The Editor will be glad to consider any MSS. sent to him for insertion in this Journal and will endeavour to return the same if unsuitable; but he cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTICE TO READERS.—If the Advertisement pages stick together, bang their edges on the table, when they should easily separate.

NOTES AND COMMENTS.

The Safety of the New Sugar Convention.

The past month has been a critical one in the history of the international negotiations relating to the Sugar Convention. The fate of the latter hung mainly on the reception of the Russian proposals by Germany. It is with a feeling of relief that we learn Germany has decided to make the best of a bad bargain and accept such advantages as she can get rather than wreck the whole Convention. She has, therefore, ratified, and the acquiescence of the other States, including England, is assured. Elsewhere, we dwell at some length on the significance of this decision on Germany's part, and also discuss the nature of the Russian agreement in so far as it affects the German sugar industry and the British sugar market. Russia's gain is problematical, so is England's, and as for Germany, she evidently thinks that the certain advantages of continuing the Convention outweigh the disadvantages arising from the "unknown quantity" of Russian bountied sugar. For the present then we are safe from any acute disturbance of the world's sugar industry, and for five years the latter will be able to strengthen the impression that it is well rid of the incubus of the bounty system. But when one considers how very unaccommodating England has been throughout the negotiations and what a great opportunity she has lost of forcing Russia into the Convention under equally stringent terms, one marvels that diplomacy has triumphed at all.

Buffers in Centrifugal Machines.

In the Court of Session, Edinburgh, on 5th February last, Lord Salvesen disposed of an action relating to a buffer used for suspending centrifugal machines. These machines are used for drying sugar, and as they revolve at a very high speed, means have to be provided for controlling the oscillations which are set up. The specifications in this case describe a buffer made of india-rubber and shaped something like a flower-pot. The plaintiffs, Watson, Laidlaw & Co., 98, Dundas Street, Kingston, Glasgow, complained of an infringement on the part of the defendants, Pott, Cassels & Williamson, Motherwell, who were alleged to have used a buffer practically the same. The defence was, *inter alia*, that the patent was bad. The Lord Ordinary held that the specification failed to disclose what was the real invention, and therefore that the patent was invalid; he accordingly gave judgment for the defendants with costs, reserving in the meantime the question of modification if any.

British Preferential Trade with Canada.

A Report upon the Conditions and Prospects of British Trade in Canada, compiled by Mr. Richard Grigg, as the result of nine months' careful enquiry in official and trading circles in the Dominion, has just been issued by the Advisory Committee to the Board of Trade on Commercial Intelligence. In treating on the sugar trade between Canada and the British West Indian colonies, Mr. Grigg has some significant information to impart. After giving a table showing the total value of sugar received from various sources during the years 1902-6, he proceeds:—

It will be seen from this table that in the last five years, and particularly since 1903, there has been a very substantial rise in the imports of sugar from the British Empire. It is considerable in the case of the United Kingdom itself, but it is most marked from the British West Indies and from British Guiana. There has also been considerable progress in the importation from Fiji, and a strikingly sudden importation from British Africa. On the other hand, the imports from foreign countries have declined with extraordinary rapidity, the German import, which was $3,653,147 in 1902 and $3,116,741 in 1903, having ceased entirely by 1906. The same fate befell the import from France (which was $1,297,066 in 1902) even earlier, in 1905. It should be observed that under the Canadian tariff sugar from the British Dominions enjoyed a preference of 33⅓%, which is continued under the new tariff. It will also be remembered that in the period under review the Sugar Convention, and the consequent abolition of the bounty system, had a very considerable effect on beet sugar production in Continental Europe. It is not possible to determine the effect of either of these forces, considered separately, but the following summary table, showing the course of the imports in the

last five years, according as they were or were not in receipt of preferential treatment, is of great interest, especially when it is borne in mind that the sugar which received preferential treatment was sugar which would not be adversely affected by the Sugar Convention.

COMPARATIVE STATEMENT—FIVE YEARS, 1902 TO 1906.

Year.	General Tariff. Lbs.	Preferential Tariff. Lbs.	Surtax Tariff. Lbs.	Total. Lbs.
1902	326,824,196	43,251,261	—	370,075,457
1903	288,150,338	100,091,559	128,935	388,370,832
1904	100,128,451	290,414,865	1,344	390,544,660
1905	71,740,809	274,863,036	148,753	346,752,598
1906	77,919,591	371,042,486	446	448,962,523

Manchurian Sugar.

In an article on the prospects of trade in Manchuria the *Trog. Prom. Gazeta* observes that Count Pototzky had recently arrived at Kharbin to erect a raw and refined sugar manufactory there. There had been reports of such an enterprise being in the air for some time, but now it is become a fact. Trials with the sowing of sugar beet were made last spring, and, as is known, turned out quite satisfactorily; in fact, the sugar contents of the beet proved to be superior to the best European varieties; and the climate proves to be absolutely suitable. Besides Count Pototzky, says the journal, a syndicate of Chinese capitalists contemplates erecting a similar factory; but, as is usual with these gentlemen, they are carefully veiling their intentions. The correspondent derives great satisfaction from the news of the Russian sugar enterprise, for the Russian article had been pressed out of the Manchurian market by foreign sugars. But it is hard to see much advantage to Russian industry if the Chinese are going to take up the running with it.

Greenock Refineries.

In the note on the Greenock Refineries which appeared in our last issue reference was made to the Cartsburn Refinery which had failed to find a purchaser in its equipped condition and had consequently been dismantled. In the present number appears an advertisement offering for sale the empty buildings and accompanying ground. It is to be hoped that now when the new Sugar Convention has been ratified for five years to come, and there is a reasonable prospect of steadier sugar markets, some parties will be induced to buy this refinery and fit it up with modern plant, and thus help to increase Greenock's output of sugar. If no offers are forthcoming, and no attempt is made to extend the refining industry in Greenock, it will hardly be surprising if the advocates of cheap sugar at any cost claim this as a proof that the abolition of the bounty system has done the British refining industry no good. We do not admit this to be the case; but we certainly think it is a matter of regret that more progress has not

been shown up-to-date. The existing refineries have certainly increased their output, but there is not a single case of a new refinery being started. We trust, therefore, that the Cartsburn property may be shortly refitted and start work again under more favourable auspices.

Australian Sugar Imports into South Africa.

A colonial paper states that some difficulties have been raised by the Natal Government in regard to sugar from Australia. Under the South African tariff they have in the past applied a discrimination against Australian sugar on the ground that it is bounty fed. The Colonial Sugar Refining Company met this difficulty by sending to Natal Java sugar, refined in Australia, though grown, cut, and partly manufactured in Java. The Natal authorities are now seeking to discriminate against this sugar, as if it were Australian. The Company is, therefore, in communication with the Federal Government with a view to approaching the High Commissioner for South Africa with a statement that the Java sugar is kept entirely separate from Australian sugar in the company's refineries, and is in no sense bounty-fed sugar.

Zambesi Sugar Plantation.

The new sugar plantation on the Zambesi, just below the junction of the Shiré and Zambesi rivers, is going ahead, there being considerable activity in the planting work and the erection of buildings, says the *Central African Times*. Four large pumps are now working steadily, and others are being imported, as the intention is to put a very large acreage under cane this year. A large number of the workers at this plantation are Nyasaland natives. There are now three large companies planting sugar cane. The output for 1907, as formerly reported, was smaller than usual, but it is hoped to have large crushings in 1908.

Sugar-growing in New South Wales.

In spite of the heavy bounties that have been paid to sugar growers in New South Wales (£263,917 since 1903-4), says the *Financier*, the area devoted to the cultivation of the cane crop is decreasing rather than extending. In 1903-4 the cane sugar area was 24,579 acres. This decreased to 20,601 acres in 1907, and a further decline is expected for 1908. About 90 per cent. of the acreage is tilled by white labour, and the remainder by black. The shrinkage is most apparent in the white labour sugar area, although it is noteworthy that, notwithstanding the diminution of 26½ per cent. in the cane sugar acreage worked by white labour, the output of sugar from this area has increased from 19,236 tons in 1903-4 to 22,000 tons in 1906-7. This falling off in the acreage devoted to sugar cultivation is, to a large extent, attributed to the superior attractions of dairy farming.

THE NEW SUGAR CONVENTION.

IV.

The German Government and the Reichstag have come to terms and the modifications of the Convention have at last been safely ratified. The Government promises to reduce the consumption duty from 14 to 10 marks per 100 k. as soon as other sources of revenue have been found to compensate for the loss. That the loss will only be temporary appears almost certain. It is sufficient to look back to 1903 for proof of this assertion. The consumption duty was then reduced from 20 to 14 marks, with the remarkable result that the revenue from sugar, instead of being reduced, was largely increased. The average annual revenue for the four years preceding the reduction was 115,900,250 marks. For the four years since the reduction the average annual revenue has been 134,839,000 marks.

This fact is so striking and important that it may be well to state the figures in detail:—

German Consumption (in Refined).

Tons of 1,000 kilos.

I.

The Four Years previous to the Reduction of the Duty from 20 to 14 marks per 100 k.

	Tons.		Kilogrammes per head of Population.
1899-1900	764,044	....	13·68
1900-1	696,565	....	12·29
1901-2..	669,260	....	11·64
1902-3 (13 months) .	728,610	....	12·45
Average	714,620	....	12·51

II.

The Four Years succeeding the Reduction of Duty.

	Tons.		Kilogrammes per head of Population.
1903-4	1,020,620	....	17·17
1904-5	867,336	....	14·42
1905-6	1,012,637	....	16·59
1906-7	1,041,625	....	16·79
Average	985,554	....	16·24

German Revenue from Sugar.

I.

The Four Years previous to the Reduction of Duty.

	Marks.
1899-1900	126,724,000
1900-1	115,691,000
1901-2	103,593,000
1902-3 (13 months)	117,593,000
Average	115,900,250

II.

The Four Years succeeding the Reduction of Duty.

	Marks.
1903-4	129,707,000
1904-5	121,734,000
1905-6	141,587,000
1906-7	146,327,000
Average	134,838,750

It is true that the abolition of the high surtax, and, therefore, of the Cartel, reduced the price to the consumer by more than the difference between 20 and 14 marks. Let us, therefore, go back to the time before the Cartel raised the price to the consumer. The Cartel came into force on the 1st June, 1900, and ended on the 1st September, 1903. The figures show that there was no decrease in consumption during the Cartel period. In the year 1899-1900 there was a temporary apparent increase, caused probably by buyers going into stock in anticipation of the Cartel.

German Consumption and Revenue previous to the Cartel.

	Tons.	Kilos. per head.	Revenue. Marks.
1895-6	668,859	12·70	103,701,000
1896-7	505,078	9·48	86,894,000
1897-8	636,399	11·75	100,871,000
1898-9	680,330	12·38	109,233,000
Average	622,666	11·57	100,174,750

The averages for the three periods of four years are, therefore, as follows:—

	Consumption. Tons.	Per head. Kilos.	Revenue. Marks.
Average of four years before the Cartel	622,666	11·57	100,174,750
Four years before the reduction of duty	714,620	12·51	115,900,250
Four years after the reduction of duty	985,554	16·24	134,838,750

We have gone into these figures rather fully because, as we pointed out in our last article, the reduction of the German sugar duty is a most important element in the sugar question at the present time. Large increase in consumption will be the great and only salvation for the important and beneficent industry of sugar production on the Continent of Europe.

Now that the additions to the Convention are practically ratified we may regard it as safely launched on another five years of mutilated existence, and we can extend our review of the situation without danger of imperilling the negotiations.

A great opportunity has been lost with regard to Russia. The two great crops in Russia of 1905 and 1906 have resulted in a surplus stock of some 500,000 tons. Previous to these crops Russia had no sugar for export beyond that which she habitually exported to Finland and Persia. Even that quantity sometimes ran short. The prohibition of the importation of bounty-fed sugar from Russia had, therefore, no practical effect in preventing the British confectioner from buying that particular article, because there was none to come. He got plenty of other sugar of a similar kind, so he had no real cause for complaint. But he went on crying out, and the new British Government declared that the wicked Convention must be at once denounced. They managed, however, thanks to their skilful diplomatists, to please—or appear to please—both parties. The Convention was maintained to satisfy its adherents, but the penal clause was denounced to please the free importer (not "trader") and to pacify the troublesome confectioner. If party exigencies had not required this piece of bad statesmanship there would have been a grand opportunity—almost a certainty—of getting Russia to join the Convention on the only reasonable terms, namely, the abolition of its bounty, or at all events the abolition of the greater part of its present reduced stimulant to overproduction. This opportunity has been lost, and at the same time the Convention has been deprived of its mainspring. Not only British producers but also—far worse as a matter of injustice and breach of faith—the other contracting States, will now have to compete once more with bounty-fed sugar on British markets. Protection to the foreign producer has once more been restored on our markets so far as sugar is concerned. That this should be done by any sane Government is sufficiently marvellous, but that it should be successfully carried out under an international agreement is even more incredible. If things had been left as they were the position of Russia, with an artificial stimulus to production which has resulted—helped by two abnormally favourable seasons—in a surplus stock of nearly half-a-million tons, would have become untenable. She must inevitably have been driven to sue for terms in order to regain the British market for her overflow supplies. To obtain admission to the Convention she would have abolished her

artificial stimulus and reduced her surtax. The abolition of sugar bounties would then have been complete. This happy ending has been frustrated, this return to free trade in sugar has been wilfully avoided, not by enemies to free trade but by those who loudly declare —not knowing what they say—that they are the "bulwarks of free trade." When will these misguided theorists and dogmatists learn that free trade means free industrial competition not free imports? Industry is the basis of trade, and, therefore, if trade is to be free industry must first be free. To make industry free we must destroy or neutralize all the artificial advantages that are wilfully interposed by foreign Governments for the purpose of giving their producers predominance over all competitors abroad. A foreign Government has a perfect right to levy a surtax on imports sufficient to keep out competition in its own markets; but when it makes that surtax four or five times as high as it need be it immediately invites its producers to raise their prices in the home market and thus create a fund with which to compensate them for losses on their surplus production. The effect is, first, to stimulate over-production, and then to enable that surplus to be sold elsewhere regardless of cost. The profit on the total production can still remain abnormally high. This our so-called free traders welcome as a positive blessing, because, forsooth, it makes things cheap for a time. Let all our industries perish, they say, so long as we can buy goods below cost price. They forget or ignore the indisputable fact that the sale of a commodity below cost price discourages all natural competition, and must, if continued, reduce and eventually destroy it, with disastrous consequences to the consumer.

This puts the argument for the defence of our industries against deliberate attacks of the assisted foreigner in fairly concise form, and sufficiently exposes the folly of re-admitting bounty-fed sugar and thus restoring the protection of the foreign producer in British markets.

It is quite possible that, if other crops are not so deficient as is at present feared in some quarters, Russian sugar may in the autumn of this year have a very serious effect on the market. The British confectioner is enjoying cheap sugar even now, but he may perhaps get it much cheaper next October. As it is, he has not much of an argument for the abolition of the sugar duty; he will have still less when he is being inundated with nice dry, white Russian sugar at a low figure. Of course he will cry out that this inroad of Russian sugar has been shut out for five years by the wicked Convention, though he knows, or ought to know, that the sugar did not exist until an exceptionally bountiful season produced it.

We pointed out in our last article that if the figures of the actual exports of Russian sugar in the past were compared with the 200,000 tons per annum which Russia is permitted to export in the future, the words "limitation of exports" would not be a very accurate or suitable expression to use with regard to figures which in reality

permit a very large increase in Russian exports. The "Memorandum on the amount of Russian sugar sent to the United Kingdom during the ten years preceding the Sugar Convention," prepared by Mr. H. Fountain, of the Board of Trade, completely confirms our assertion. But the wording of the title of the memorandum is not, perhaps, quite accurate. It should be "Memorandum of the maximum amount of Russian sugar available for the United Kingdom, &c."

Here are Mr. Fountain's figures:—

	Exports of sugar from Russia, recorded as having been sent to Germany, the United Kingdom, or Finland. Tons.	Imports of Russian sugar into Finland either directly or *via* Germany. Tons.	Maximum amount of Russian sugar available for the United Kingdom. Tons.
1894	39,200	6,800	32,400
1895	20,900	8,400	12,500
1896	119,500	10,500	109,000
1897	46,700	10,600	36,100
1898	44,600	19,800	24,800
1899	50,300	24,200	26,100
1900	89,300	31,000	58,300
1901	47,700	29,800	17,900
1902	52,000	27,900	24,100
1903	109,000	32,900	76,100
	Average		41,700

Mr. Fountain concludes: "Thus the maximum amount of Russian sugar which could have been sent to the United Kingdom in any of the ten years preceding the Convention could hardly have been greater than 100,000 tons, whilst the average amount was probably less than 40.000 tons."

This average of less than 40,000 tons is permitted to be increased to 200,000 tons; and the operation is called a limitation of exports. This is the "concession" made by Russia which has induced Germany to accept the situation involved in the withdrawal of Great Britain's undertaking on the faith of which Germany and the other producing States abolished their bounties.

It is unfortunate that no effort appears to have been made to induce Russia to make a very simple change in her present system which, without touching her fiscal arrangement, would have removed, as we have repeatedly pointed out, a great part if not the whole of the incentive to over-production. In the case of Russia the high price in the home market would not impel producers to produce too much if the share of each factory in the home market consumption were fixed definitely and finally. It is only because it is possible for the share to be increased by the increase in the output of the factory that producers are actually driven to a constant striving for a larger share in the protected market. The simple remedy for this evil is to

fix finally the share of each factory. It does not appear to be a change which would have any effect on the fiscal interests of the Government, nor does it seem to be in any way injurious to the producer's interests. On the contrary, he does not want to glut the market with a surplus stock of sugar which probably he will be unable to get rid of except at a loss. He is driven against his will to increase his production in self defence, because he knows, or thinks, that if he did not he would lose a portion of his present share in the home trade. His competitors would increase their production, and as their shares increased his would diminish. There is, therefore, a general scramble to produce more, the result being that the shares remain much the same, but a great deal too much sugar is produced. A great opportunity has been lost in not driving home this very simple, harmless and effectual remedy for the main flaw in the Russian system.

Mr. Fountain's figures are substantially correct. It is well known that in the year 1896 there were large importations from Russia, which, as often happens in such cases, came very opportunely to check what might otherwise have been a serious rise in the price of sugar owing to deficiencies in other quarters. This large inroad of sugar from Russia was quite exceptional and it is perfectly true, as pointed out by Mr. Fountain, that our ordinary supply of Russian sugar did not exceed about 40,000 tons. At the moment when the Convention came into force the stocks of surplus sugar in Russia had run down almost to vanishing point and it took two bumper crops to restore them to the figure at which they now stand. During the interval, that is for about three years, there was no sugar in Russia for export beyond the requirements of Finland and Persia, and therefore there was no shutting out of supplies from Russia, because they did not exist. If the price of sugar remains low up to September there can be no doubt that the marketing of the Russian stock will be a difficult and costly operation, and the Russian producers will have little heart for large sowings in 1909.

Sir Henry Bergne, in his report of December 2nd, 1907, says very truly, apropos of Mr. Fountain's memorandum :—

"It seems evident, therefore, that the acceptance of the draft Protocol, with its limitation to 200,000 tons per annum as the amount of sugar which Russia can export, free of excise duty, to the European market, can practically have no prejudicial effect in curtailing supplies of Russian sugar for the English market, since it is difficult to suppose that Russian sugar production can, in so short a period as five years, attain such increased proportions as to permit Russia to export to England an average of more than five times as much as she had previously been able to do."

So much for the concessions made by Russia which have gained for her the privilege of entering the Convention.

THE ADHESION OF RUSSIA TO THE BRUSSELS CONVENTION.

Official Correspondence.

The Official Correspondence respecting the adhesion of Russia to Brussels Sugar Convention has lately been issued as a Parliamentary Paper (No. Cd 3877). The principal letter is from Sir Henry Bergne who reports on the Special Session of the Permanent Sugar Commission.

The main points of his communication were as follows:—

December 2nd, 1907.

The Permanent Commission, established under the Sugar Bounties Convention, held a special Session, opening on Monday, the 18th November.

The principal matter for the consideration of the Commission at this Session was the application of Russia to become a party to the Sugar Convention upon special terms.

It will be recollected that at its last Session, held in July this year, the Commission prepared and submitted for the acceptance of the Governments of the Contracting States a draft Additional Act, containing stipulations to the effect that the Sugar Convention should be prolonged for a further period of five years, from the 1st September, 1908, on certain special conditions, the chief of which was that Great Britain should, after the 1st September, 1908, be exempted from the obligation to prohibit or levy countervailing duties upon bountied sugar. At the conclusion of the July Session of the Commission it was announced that a proposal for admission to the Convention upon special terms would shortly be received from the Russian Government.

The draft Additional Act thus submitted was accepted and signed by all of the Contracting States in the month of August last, but the German Government gave it to be understood that their ratification of the instrument must depend upon the admission of Russia to the Convention upon terms which were acceptable to the great sugar-producing States.

The present meeting of the Commission was therefore a very important one, since upon its result hung the admission or rejection of the Russian application to join the Convention, and consequently the ratification or failure of the Additional Act. If the latter should not be ratified, it is open to His Majesty's Government to give, on or before the 1st March next, notice of their intention to withdraw from the Convention. In that event, it is probable that the Convention will terminate entirely, and that the former surtax in Germany will

be revived, and with it the cartel and the bounty thereby created. A statement made by the German Delegate at the 55th sitting, on the 19th November last, points clearly to this result.

The Russian system, as is well known, establishes a very high surtax, or excess of customs duty over the excise, and in their application to join the Convention the Russian Government had volunteered to make a slight reduction in the existing surtax.

When the subject came on for discussion at the present session of the Commission, it was at once manifest that the reduction offered was not sufficient to satisfy Germany and the other great European sugar-producing States, and it was recognised that the task of reconciling divergent interests which lay before the Commission was one of no ordinary difficulty.

At the preliminary meeting, held on Monday, the 18th November last, four methods of compromise were suggested:—

1. Reduction of the Russian surtax to a satisfactory figure.
2. Fixation of a maximum selling price for domestic consumption in Russia.
3. Establishment of an export duty on Russian sugar.
4. Some change in the present system in regard to exportation of sugar from Russia.

A Russian delegation, consisting of five members, had arrived in Brussels and was admitted to the next and to all the subsequent sittings of the Commission. The chief of this delegation, M. B. Priléjaieff, conducted the discussions on the Russian side with extreme ability and courtesy, and showed a sincere desire to reach a satisfactory settlement.

A prolonged debate ensued, lasting over more than a fortnight, during which various solutions were discussed, but it eventually became apparent that no change in the existing Russian system was to be hoped for of such a character as to satisfy Germany and the other sugar-producing States, unless a solution could be found in the direction of some alteration in the system of exportation, leaving the existing Russian system in regard to sugar, including the surtax, otherwise untouched.

In regard to this, I stated that His Majesty's Government would greatly prefer a solution which did not involve a limitation of any kind in regard to Russian exportation of sugar, but that although they could not promote any settlement involving such limitation, yet under the special circumstances of the case, they would not feel it to be their duty to oppose an agreement which might be acceptable as between Russia and the other Contracting States.

Eventually the following draft Proctocol was unanimously agreed to by the Russian and all the other delegations. It will shortly be submitted by the Belgian Government to the Governments of the

Contracting States for acceptance and signature by their diplomatic Representatives at Brussels.

It is understood that this draft Protocol and the Additional Act stand or fall together, and that failure to sign and ratify the draft Protocol would imply the rejection of the Additional Act.

I should state that I did not take any active part in the elaboration of this scheme, which I maintained was a matter rather for settlement between Russia and the other sugar-producing States. My efforts were confined to endeavouring to secure that any agreement arrived at was of such a character as to permit of the exportation of a sufficient quantity of Russian sugar, free of excise duty, for the needs of the English market.

DRAFT PROTOCOL.

The Imperial Russian Government having expressed the desire to adhere to the Convention of the 5th March, 1902, relative to sugar, as well as to the Additional Act to the said Convention signed on the 28th August, 1907, and the States at present belonging to the Sugar Union having recognized that this adhesion cannot, on account of the special conditions of the sugar industry in Russia, be subordinated to the general conditions of the Convention, it has been agreed as follows between the Government of Russia on the one hand and the Governments of Germany, Austria-Hungary, Belgium, France, Great Britain, Italy, the Grand Duchy of Luxembourg, the Netherlands, Peru, Sweden, and Switzerland on the other hand :—

ARTICLE 1.

Russia adheres to the Convention relative to Sugar of the 5th March, 1902, amended by the Additional Act of the 28th August, 1907, with all the advantages and all the obligations which it entails, with the reservations and subject to the conditions referred to in the following Articles.

ARTICLE 2.

Russia shall retain her present fiscal and customs legislation as regards sugar, and shall not increase the advantages which might result, in favour of the producers, from the maximum sale price fixed for the internal market.

ARTICLE 3.

In consideration of the special arrangements which are allowed to Russia by the preceding Article, she undertakes not to authorize the exportation, with return of or exemption from excise, of quantities of sugar exceeding the maximum figure of 1,000,000 tons for a period of six years, beginning on the 1st September, 1907.

This contingent will be divided among the different sugar seasons according to the requirements of trade, but in such a way that the quantity allotted to each season shall not exceed the following figures :—

	Tons.
Double season from September 1st, 1907, to August 31st, 1909	300,000
Season from September 1st, 1909, to August 31st, 1910	200,000
,, ,, 1910, ,, 1911	200,000
,, ,, 1911, ,, 1912	200,000
,, ,, 1912, ,, 1913	200,000

The engagements mentioned in this Article do not apply to exports—

1. To Finland.

2. To Persia (for exports *via* the Caspian Sea and the land frontier and not for those *via* the Persian Gulf); and

3. To the other Asiatic countries adjoining Russia (for exports *via* the land frontier only) with the exception of Turkey in Asia.

ARTICLE 4.

The accession of Russia will come into force from the 1st September, 1908.

During the Session preceding the 1st September, 1912, the Permanent Commission shall decide by an unanimous vote as to the treatment to be accorded to Russia, should she be disposed to continue to be a party to the Convention beyond the limit of the 1st September, 1913.

In the event of the Commission not being unanimous, Russia shall be considered as having denounced the Convention, the denunciation to take effect from the 1st September, 1913.

ARTICLE 5.

The present Protocol shall be ratified and the ratifications thereof shall be deposited at Brussels, at the Ministry for Foreign Affairs, as soon as possible, and in any case before the 1st February, 1908.

Done at Brussels the 19th December, 1907, in single copy, a certified copy of which shall be delivered to each of the Signatory Governments.

I may perhaps be permitted to make the following remarks as to the effect of this draft Protocol.

The reason why the present year's sugar campaign, viz., from the 1st September, 1907, to the 31st August, 1908, has been included in the arrangement is as follows:—

Large stocks of sugar, estimated at nearly 500,000 tons, have accumulated in Russia. These cannot find a market in England until the 1st September, 1908, but it was feared by Germany and other States that large quantities of this sugar, exempted from payment of excise, might be sent out of Russia before the 1st September, 1908, and placed in bond in foreign ports, with a view to subsequent export to England. The quantities so dispatched out to Russia would not have been reckoned in the contingent exempt from excise duty fixed for the year the 1st September, 1908, to the 31st August, 1909, if that year had been taken as the first year of the arrangement. Hence the stipulation that 300,000 tons, exempt from excise duty, should be allowed for the double year the 1st September, 1907, to the 31st August, 1909.

It may be considered that the provisions of the draft Protocol allow a sufficient quantity of the Russian accumulated stock to be placed on the London market within a reasonable time. If the Protocol be accepted and ratified, the exportation to Europe, free of excise duty, of the accumulated stock of 500,000 tons must be spread over a period of at least three years, according to demand,

with a maximum of 300,000 tons for the first two years, the 1st September, 1907, to the 31st August, 1909, and of 200,000 tons for each of the ensuing years. The practical effect of this, so far as the United Kingdom is concerned, would be that, instead of it being possible to swamp the English market at any moment after the 1st September, 1908, with the whole 500,000 tons of accumulated stocks, the operation must now be spread over at least two years; 300,000 tons only, free of excise duty, being at the outside available for the year the 1st September, 1908, to the 31st August, 1909, and 200,000 tons for the year the 1st September, 1909, to the 31st August, 1910, or any subsequent year.

It is noteworthy that almost the whole of the sugar exported by Russia for the European market will be available for the United Kingdom, since Russian sugar exports to other European countries will always be of a very limited character.

In a Memorandum prepared by Mr. H. Fountain, of the Board of Trade it is estimated that the average annual importation of Russian sugar into the United Kingdom, calculated on the ten years preceding the prohibition of Russian sugar, cannot have exceeded 40,000 tons; whilst in no one year can a larger amount than 100,000 tons of Russian sugar have been received by Great Britain.

It seems evident, therefore, that the acceptance of the draft Protocol, with its limitation of 200,000 tons per annum as the amount of sugar which Russia can export, free of excise duty, to the European market, can practically have no prejudicial effect in curtailing supplies of Russian sugar for the English market, since it is difficult to suppose that Russian sugar production can, in so short a period as five years, attain such increased proportions as to permit Russia to export to England an average of more than five times as much as she has previously been able to do.

I may mention that another proposal was made by the Russian Delegate, and warmly supported by me. It was to the effect that, as an addition to the arrangement contained in the draft Protocol, it should be permissible for Russia to submit to the International Sugar Commission a proposal to augment the amount of sugar free from excise tax which she will be allowed to export to Europe in any year when on account of scarcity of crop, or other circumstance, the price of sugar may have risen to a very high figure. This proposal embodies a valuable safeguard for times of deficient supply, although it is not very likely that, if a serious shortage of the European crop should occur, Russia would have sufficient surplus to export more than 200,000 tons of sugar to Europe in that particular year. The proposal, however, was not insisted upon by the Russian Delegate as part of the actual settlement, but it was understood that the various delegations should bring the matter to the notice of their respective

Governments, with a view to its being either made the subject of diplomatic correspondence, or to its being considered at the next session of the Commission.

If the draft Protocol should be signed and ratified by all the contracting States Russia will become, on the 1st September next, full party to the Sugar Convention of the 5th March, 1902, and to the Additional Act of August, 1907, subject to the conditions laid down in the draft Protocol. This accession will carry with it the consequence, amongst others, that Russian sugar exported after the 1st September next will be regarded as unbountied, and it will not consequently be necessary to consider Russian sugar as bountied sugar for the pupose of the certificates of origin to be issued with refined sugar when exported by Great Britain to other contracting States, in accordance with the engagement contained in the Additional Act.

The British Delegation on this occasion was composed, besides myself, of Mr. A. A. Pearson, C.M.G., late of the Colonial Office, and Mr. H. Fountain, of the Board of Trade, as Assistant Delegates, and of Mr. G. H. Villiers, of the Foreign Office, as Secretary to the Mission. My best thanks are due to all these gentlemen for assistance rendered to me.

In conclusion, I would venture to suggest that, if the draft Protocol elaborated by the Commission should be accepted by His Majesty's Government, instructions to sign it should be sent to His Majesty's Minister at Brussels as soon as possible after it has been received from the Belgian Goverment. The signature should take place during the present month in order to permit of its being submitted to the Parliaments in those countries where this step is necessary before the ratifications can be exchanged.

If approved by the various Parliaments, the ratifications of the draft Protocol should be exchanged on or before the 1st February, 1908, simultaneously with those of the Additional Act.

I have, &c.,

(Signed) H. G. Bergne.

In order to counteract the power of the recently formed Swedish Sugar Trust, the Swedish Finance Minister is credited with a desire to pass a Bill to levy a manufacturing tax of 23 per cent. on sugar made in Sweden and at the same time to lower the Customs duty on imported sugar. It is, however, considered that if any such Bill becomes Law it will result in the virtual ruin of the Swedish sugar industry.

INDUSTRIAL ALCOHOL AND THE SUGAR PRODUCING COLONIES.

Under the heading "Openings for the British Motor Industry", the writer of the present article has, in the *Engineering Supplement* of the *Times* of the 15th January last, shown what a good market the sugar producing colonies would be to the British motor trade if the sugar producers were presented with alcohol internal-combustion engines meeting their requirements. It is here the object of the writer to bring forth the advantages which the sugar growers would derive from using such engines, and from spreading, as much as possible, the uses of denatured alcohol.

One of the most important results forced upon the sugar cane planter by the keen competition of the large beetroot sugar producing countries is the necessary reduction to a *minimum* of expenses in every possible direction. In fact, the history of the sugar cane industry of the late years brings out in relief a continuous struggle for the lowering of the cost of production. This can be effected in two main ways: firstly by the introduction of more modern machinery enabling a greater percentage of sugar to be extracted from the cane, and secondly by reasonably economizing, in every possible detail, upon the different expenses connected with the growing and manufacturing of sugar from the moment when the canes are put into the ground to the moment when the sugar is sold. The first of those two methods of reducing cost-production involves the new investment of considerable capital, and should only be resorted to after all the possible economies in the many details in the manufacturing with the existent machinery have been made. The view we are now expressing does not prevent improvements being gradually introduced into the machinery and methods used; but all changes, involving new expenses, should only be made after we have ascertained two things: firstly, that we have employed the means at our disposal with a *maximum* of efficiency at a *minimum* of cost; and, secondly, that the new arrangement we are going to adopt is without doubt advantageous.

Few sugar cane growers will to-day question the advantages of having the sugar fields connected with the mill by a network of tram lines, and a very great number of factories possesses a system of tramway which ensures a quick and reliable means of transport whenever wanted. Now, considering the question of transport by tramway from a sugar grower's point of view, let us see if the means at his disposal is employed with a *maximum* of efficiency at a *minimum* of cost. The question of efficiency can only be decided by the individual grower in each particular case, but that of cost can be treated in a general manner. One of the heavy expenses in the transport by tramway is the cost of the fuel necessary to work the steam engines.

In most, if not in all, cases coal is the fuel used for that purpose, and in many colonies the price of that combustible is very high indeed. It seems then that, if the sugar grower could use, instead of coal, a fuel which he can obtain very cheaply, serious economies would be made on the cost of transport. Now the experience of many years has proved that the internal combustion engine can be relied upon, and that alcohol can be used with great efficiency in such an engine. If the sugar grower, therefore, can have to work his tramways an alcohol motor, the economies he would make on the transport item would be very great indeed, for he will be using as fuel a by-product of his industry which can be obtained at a very low price.

The amount of alcohol that can be obtained from the sugar cane as a by-product of sugar is very great. Moreover, the percentage of sugar left in the cane-trash, or bagasse, after it has gone through the series of rollers is quite appreciable, and can be easily converted into alcohol. Up to the present many colonies ignore that percentage of sugar left in the bagasse, and simply use that bagasse either as a fertilizer or as a part of the fuel used for driving the factory machinery. It is easy to prove the wastefulness of such a system. If the bagasse is used as a fertilizer, then some of the chemical elements contained in it and which may be converted into alcohol are put into the ground without any beneficial effects, for these elements do in no way assist vegetation. On the other hand, if the bagasse is burnt after it comes from the rollers, then the scarcer elements and salts, such as nitrogen and phosphates, which it contains and which are so needed for vegetable growth, are wasted away. In the first case no use is made of the alcohol contained in the bagasse, and in the second attention is paid neither to that alcohol nor to those fertilizing elements which the bagasse contains and which would be so useful in the fields. In both cases, therefore, it would be to the advantage of the sugar producer to extract from the cane-trash the alcohol it contains before burning it or before using it as a fertilizer.

Alcohol from molasses and from bagasse can be produced very cheaply, and the more so if several neighbouring growers unite to have a common distillery between them. If that alcohol is used in internal combustion engines whose reliability has now been proved by actual experience, and if the sugar grower could have such a motor to work his tramways no doubt great economies would be effected on the transport item. Besides, the use of the alcohol motor would dispel the danger of the canes catching fire from sparks from the locomotive.

As stationary engines, too, the alcohol motor will be found very reliable and very useful to the sugar grower. There is actually in use in Cuba, where alcohol is sold very cheaply for industrial purposes, a great number of such motors working electric and water

plants. Among the uses to which the alcohol motor can be put by the sugar grower are the following:—It can be used to work the wire-rope machinery on estates having such a system of transport, or where such a system can be installed; it can be used to drive dynamos to supply electric light to the factory and to the buildings connected with the factory; it can be used to work the different machinery in the workshop which every factory possesses; it can be used in certain colonies for ploughing, and in other colonies to work the scrapers employed by some sugar growers in the preparation—as a secondary industry—of the aloe fibre; and, generally, it can be made to supply the demand for small engines working at a small fuel cost.

Many colonies have now obtained reduced taxes on denatured alcohol. In England there is, since 1855, no tax on denatured alcohol, and it is therefore very probable that the Home Government would meet the wish of the colonies were they to ask for a further reduction from the tax on alcohol used for industrial purposes.

Economies on the cost of fuel as a power raiser are not the only advantages which the sugar grower could derive from the use of alcohol. Alcohol can be used economically and efficaciously for domestic purposes, such as heat and light, and if the planters were to spread the use of alcohol for such purposes they would, in the very near future, have an increasing demand for the by-product of their industry, since the price of petrol will most likely rise.

There is a widespread idea that alcohol is more dangerous than petrol (gasoline) to handle. This is quite erroneous, and alcohol on fire can be more easily dealt with than petrol from the fact that alcohol mixes freely with water in all proportions, whilst petrol floats on water.

In the preceding lines it has been shown that the sugar grower, by using alcohol, will obtain many advantages both as a consumer and as a producer. As a consumer he will obtain cheaper power and will have to rely to a less degree upon fuels the price of which is beyond his control. As a producer he will find a good market for a by-product of his industry, and this will further assist him in his competition against the large beetroot sugar producing countries.

L. Blin Desbleds.

The North Brazilian Sugar Factories Limited have just recently registered £15,000 seven per cent. debentures, which are charged to the company's undertaking and property, present and future, subject to such of the first mortgage debentures as may be outstanding. No Trustees have been appointed.

AN EXPLANATION OF THE OCCASIONAL ABNORMALLY HIGH QUOTIENT OF PURITY OF CANE JUICE.

By H. C. Prinsen Geerligs.

In the *International Sugar Journal*, 1900 (page 145), I mentioned some cases of abnormally high polarization of cane juices "to such a degree that the sucrose content calculated from them exceeds the figure for any substance as indicated by the Brix hydrometer." From this quotation it is obvious that the readings of the Brix spindle were considered as the true basis on which the calculations depended, while the polarization was considered a doubtful figure. In fact in every case where a juice showed a very high quotient or changed its quotient rapidly and appreciably during manufacture, the figure obtained by the polariscope was always suspected of being influenced by other substances than sucrose. We always presumed the existence of foreign bodies having a remarkably high dextro-rotatory power, or changes in the polarization of the sucrose itself by changes in the concentration, in the acidity or alkalinity, or in the temperature deviations. In no case did the idea occur to me that the Brix readings could have been affected by the presence of another solvents than pure water so as to make the specific gravity of the mixture much less than was equivalent to the proportion of dry substance.

In the above-mentioned paper I quoted the case of a cane juice having a very high quotient of purity, which, however, gradually sank till it had reached the condition of ordinary syrup and then did not alter any more. I looked in vain for high polarizing bodies other than sucrose and could not succeed in tracing one of them or even the products of decomposition of some such highly dextro-rotatory body. I therefore summed up as follows at the end of my paper: "The problem of the cause of these abnormally high polarizations is therefore not yet elucidated." Now I see that those mysterious phenomena and their unaccountable disappearance on evaporation can easily be explained by the hypothesis of the presence of a small amount of alcohol or a similar liquid of low specific gravity in the juice. This causes the specific gravity of the juice and therefore the Brix to fall considerably, producing a corresponding rise in the quotient of purity calculated with the aid of these erroneous figures. On evaporation the alcohol volatilizes, and remains, at the temperature of the evaporating vessels, in the state of a non-condensible gas which is at once sucked away by the air pump and disappears for good in the waste water. The syrup thus freed from this light volatile constituent does not contain any other solvent than water, and as a matter of course the true degrees Brix and the true quotient are now found on analysis.

I therefore mixed cane juice with different quantities of alcohol and determined degrees Brix, polarization, and quotient in the ordinary way. The results were as follows :—

	Original Juice.	Juice mixed with Alcohol. 1 per cent.	2 per cent.	5 per cent.	10 per cent.
Degree Brix	17·55	16·85	16·45	15·26	12·64
Polarization.. ..	15·51	15·47	15·16	15·04	14·64
Quotient	88·37	91·81	92·16	98·55	115·82

These figures show clearly that the mere presence of alcohol will cause any normal cane juice to yield an unaccountable high purity on analysis and it is also clear that that same juice will revert to its original normal purity as soon as the alcohol is evaporated by boiling.

Alcohol is not an uncommon constituent in mill juice. I found in my laboratory book, that the cane from which the juice, mentioned in the 1900 article, had come had suffered from stagnation of growth in its youth. Raciborski mentions attacks of a yeast *Saccharomyces apiculatus* in sugar cane which yeast is conspicuous for its property of only fermenting glucose and not sucrose, and therefore purifying a cane juice in such a way that the glucose disappears while the sucrose remains, by which proceeding the real purity rises, not to speak of the one calculated from the specific gravity, which is artificially lowered by the presence of the alcohol formed on fermentation. Went and Prinsen Geerligs mention that the fungus of the pineapple disease or black rot, the *Thielaviopsis ethaceticus*, forms ethylic acetate as well as alcohol from sugar-containing substrata. Further, it is not impossible that in the broken cells of fallen or choked cane, or during the transport and storing of cut cane in a hot climate, an intercellular fermentation sets in, causing the mill juice to contain more or less alcohol. Finally, the fact that the purity of the mixed juice of the three mills shows the highest quotient, and even a higher quotient than one of its constituents, is easily explained, if we consider that this juice is sampled after the measuring tank is filled, whilst the other juices are sampled from the gutters without delay. They therefore come up much earlier for analysis, whilst the mixed juice can find a longer opportunity for fermenting and increasing its alcohol content.

During our last harvest I tried to obtain cane suffering from black rot or red smut, but these diseases appear to have become so thoroughly stamped out that I was at a complete loss to find any, so the direct proof of my hypothesis is not yet available. I am, however, glad to have succeeded at the eleventh hour in detecting the cause of these abnormal quotients, for younger confrères of mine have more than once asked for an explanation of the fact that they had as yet never come across such unusual figures for the purity. Now the answer is a very simple one, viz., that the energetic measures suggested for combatting the epidemical sugar cane diseases and the earnest warnings issued against keeping the already cut cane too long in the field, or

on the road or in the factory, have borne such good results that they have done away with the cause of the abnormal figures. But we have still to consider the question of how to detect in a simple way when a cane juice contains alcohol or similar constituents apt to change its quotient to all appearance. Here I found in the refractometer a good auxiliary. The refractive index of alcohol is higher than that of water, therefore water containing alcohol will show the same index as if it contained sugar or any other dissolved constituent. When tested in the refractometer, a solution containing water, alcohol and sugar will therefore show a higher index than corresponds to the actual amount of dry substance, so that with the refractometric test, an excessively high figure for the dry substance and consequently a too low figure for the purity will be found while by the determination of the specific gravity or degrees Brix just the reverse will be the case. The following table, where the same cane juice was mixed with alcohol in different proportions and analysed (1) in the usual way and (2) with the refractometer, will give a good instance of this difference.

Per cent. Alcohol.	Degrees Brix at 17·5° C.	Polarization.	Refractive index at 28° C.	Dry substance after Brix.	Dry substance after refractive index.	Quotient after Brix.	Quotient after refractive index.
0	17·94	15·84	1·3589	17·24	17·7	88·29	89·5
0·5	17·53	15·78	1·3592	17·53	17·9	90·01	88·2
1	17·23	15·73	1·3595	17·23	18·05	91·29	87·1
1·5	17·03	15·67	1·3600	17·03	18·4	92·17	85·2
2	17·00	15·65	1·3600	17·00	18·4	92·05	85·0

Now we can see at once whether a juice belongs to those having an abnormal quotient or not, by the difference in the percentage of dry substance after the Brix readings and after the refractive index respectively. If we find a difference of about 1% or even more, we may presume that there is still another solvent than water in the juice, and we can easily detect this by distilling the juice. For that purpose we fill a flask containing 1 litre half full of the juice, boil, and distil off the first 10 ccm. An experienced eye can at once see from the appearance of the first condensing drops whether the juice contains alcohol; but at any rate we can add to the distillate 2 ccm. soda solution and 20 ccm. of deci-normal solution of iodine in iodide of potash (not iodine tincture), shake well, and wait half an hour. If after that there is any cloudiness or precipitation of iodoform, the distillate must have contained alcohol; in the contrary case, it and also the initial juice were of course free from this substance.

SOME POINTS IN MULTIPLE EVAPORATION.

By F. I. Scard, F.I.C.

One of the many vexed problems with which multiple evaporation bristles lies in the apparently abnormal relation of the boiling points of the several vessels. All users of triple effects in sugar factories must have been struck by the fact that the difference between the temperatures of the first and second vessels is much less than that between the second and third, whereas in a theoretically perfect multiple effect there should be even distribution of temperatures.

In a triple effect where there is no loss of heat from radiation, or interference with conductivity, the number of units of heat going to the first vessel would be represented by $S + L$, to the second by $S_1 + L_1$, and to the third by $S_2 + L_2$: where S, S_1, S_2, and S_3, and L, L_1, L_2, and L_3, represent the sensible and latent heat respectively of the juice and vapour. As $L_1 = S + L$, and $L_2 = S_1 + L_1$, it follows that the units of heat going to the three vessels would be, to the first vessel $S + L$, to the second $S + S_1 + L$, and to the third $S + S_1 + S_2 + L$. These figures however do not represent the work actually done in the way of evaporation in the several vessels on account of the latent and specific heat varying with the temperature. If, however:—

W = weight of liquor entering first vessel at temperature t.
W_1 = ,, ,, second ,, ,, t_1.
W_2 = ,, ,, third ,, ,, t_2.

S_1 = specific heat of liquor corresponding to t_1.
S_2 = ,, ,, ,, t_2.
S_3 = ,, ,, ,, t_3.
K_1 = ,, water ,, t_1.
K_2 = ,, ,, ,, t_2.
K_3 = ,, ,, ,, t_3.

A = weight of steam entering first calandria at temperature T.

Then evaporation in first vessel

$$= \frac{\frac{W(t - t_1)}{S_1} + A\left(\overline{1115 - \cdot 7T + \frac{T - t_1}{K_1}}\right)}{1115 - \cdot 7t_1} \quad (a).$$

Evaporation in second vessel

$$= \frac{\frac{W_1(t_1 - t_2)}{S_2} + \overline{W - W_1}\left(\overline{1115 - \cdot 7t_1 + \frac{t_1 - t_2}{K_2}}\right)}{1115 - \cdot 7t_2} \quad (b).$$

Evaporation in third vessel

$$= \frac{\frac{W_2(t_2 - t_3)}{S_3} + \overline{W_1 - W_2}\left(\overline{1115 - \cdot 7t_2 + \frac{t_2 - t_3}{K_3}}\right)}{1115 - \cdot 7t_3} \quad (c).$$

For the sake of simplicity let us suppose that water be the body evaporated, in which case $S_1, S_2, S_3 = K_1, K_2, K_3$, respectively, and that the temperature t of $W = t_1$. As the conditions are supposed to be perfect, there will be equal differences of temperature between the vessels. If, therefore, T be taken as 220°F. and t_3 130°F., t_1 will equal 190°F. and t_2 160°F. K_1 will consequently be 1·0044, K_2 1·0030, and K_3 1·0020.

If these values be substituted in the above equations:—

$$(a) = 1{\cdot}009A.$$
$$(b) = 0{\cdot}03046W + 1{\cdot}008A.$$
$$(c) = 0{\cdot}05906W + 0{\cdot}958A.$$

If the evaporation be 75% as is the practice in cane sugar factories,

$$\cdot75W = \cdot08951W + 2{\cdot}975A$$

in which case

$$A = \cdot222W.$$

The respective evaporations are thus:—

First vessel	·222W
Second vessel	·254W
Third vessel	·272W

which are in the relation of 1 : 1·144 : 1·225.

It is thus seen that with unimpeded conductivity in the heating surface and no loss from radiation—in fact, under perfect conditions of condensation, the work done by the vessels increases as the series progresses.

Now as mentioned above, in practice the equal division of temperature does not occur. With an initial steam temperature of 220°F. and an ultimate temperature in the third vessel of 130°F. the temperature of the first and second vessels would be nearer 200°F. and 175°F. respectively, than 190°F. and 160°F. which have been taken above.

Various explanations have been given as the cause of this apparently anomalous condition. The one that immediately suggests itself is that the increase in the number of units of heat going forward means extra work in the way of condensation and that the temperature of the earlier vessel is automatically raised so as to permit of the condensing surface in the subsequent vessel being more efficient. Another theory is that the rarification of the vapour as the vacuum increases leads to a lesser number of molecular impacts per unit of heating service in a given time, while another is based on the fact that the conductivity of the water film on the vapour side of the heating surface is lowered with the temperature, automatic raising of the temperature from insufficient condensation taking place in both instances. Further, that the increased non-conductivity of the syrup as it becomes concentrated leads to the same result.

All these theories are based on increased difficulty of condensation in the face of increased work in the third, and to some extent in the

second, vessel of the triple, and at once suggest that the way out of the difficulty would be to increase the heating surface of the vessels both in proportion to the work to be done and the difficulty of condensation. If they are correct then a triple effect in which provision has been made for increase of condensing power in the second and third vessels, as compared with that of the first, should show equal, or approximately equal, divisions of temperature. This however is not the case. Some years ago it was the practice to provide triples in which the heating surfaces were in an increasing ratio, the first vessel being the smallest and the third the largest. *The distribution of temperature in these triples was the same as is noticed in triples of equi-sized vessels.* Film evaporators show, also, the same temperature relation as bulk. Further, the writer has experimented with ordinary triples, blocking the heating surface in the first and second so as to give a ratio of 5 : 7 : 10, and *no alteration whatever was noticed in the distribution of temperatures as compared with the same triples in their ordinary condition.* In these instances the heating surface in the first vessel was reduced to half of that in third and should have made ample allowance for meeting the conditions as regards condensation supposed to exist by the above theories. Were they correct there should be some evidence of it observed in the temperature.

The figures showing the relative work thrown on the vessel were calculated on an evaporation of 75%. With 50% evaporation the ratio of work would be for the three vessels, as

$$1 : 1{\cdot}21 : 1{\cdot}37$$

If the work of an evaporator be reduced to the lower figure, on the above hypothesis there should be some indication in the distribution of temperatures of the altered relation. The writer can speak from experience that it is not so. From the point of view of practice it is impossible to look upon any of the theories up to now advanced on the subject as being in any way satisfactory.

Apart from the question of temperatures, however, this ratio of heating surfaces in the vessels is a matter of interest. The condensing power of the third vessel is the measure of the work of an evaporator, provided that the juice be introduced into the first vessel at a temperature not less than its boiling point. In this case, the first vessel of an equi-vessel triple does no more work than if it were half the size. In the triple experiments mentioned above, where the heating surfaces of the first and second vessels were blocked so as to give the relation of 5 : 7 : 10, the work done by the evaporator as a whole was quite equal to what it had been before blocking. In many factories, however, the juice enters the evaporator at a comparatively low temperature, say 160° F., and where this is the case the first vessel has, in addition to its normal work, to do duty as a juice heater. This would justify excess of size in the first vessel, but not in the

second, of which the power of work is measured by the condensing power of the last vessel.

There is another subject in connection with multiple effects which requires investigation, and that is the experimental determination of the work actually done by the several vessels under different conditions. The strides which have been made in recent years in connection with evaporators are apt to make us think that the field of multiple evaporation is covered, and to make us lose sight of the fact that some of the most important problems in connection with the subject still remain unsolved. The actual determination of the evaporation done by the several vessels of evaporators under different conditions would do much to throw light on them, and especially on the question of temperature relations.

THE ESTIMATION OF DRY SUBSTANCE IN SYRUPS BY MEANS OF THE REFRACTOMETER.

By Professor Dr. E. O. von Lippmann.

For some years past quite a number of chemists and physicists have worked at the problem of the refractometric investigation of pure sugar solutions by means of the refractometer; but the rsults of their experiments (to be found in my work, "Die Chemie der Zuckerarten") have remained inaccessible for practical application partly because the apparatus required for measuring the refraction was too complicated, and partly because in the case of pure and dilute syrups no resort to new methods was felt to be necessary. Just lately, however, the firm of Zeiss, of Jena, have placed on the market an improved Abbe Refractometer, the excellent construction and easy adjustment of which makes it particularly adaptable to the daily requirements of a sugar factory; and the price is also a reasonable one. Tolman and Smith, Main, and especially Prinsen Geerligs, have obtained excellent results with this apparatus and the last named has pointed out that the impure products of the factory can also with a few exceptions be tested without needing to be diluted.

In order to demonstrate the availability of this apparatus in connection with the products of the beet sugar industry, some experiments were recently carried out in the laboratories of the Halle sugar refinery under the superintendence of the chemist, Herr Hübener. The experiments were undertaken chiefly on different mother-syrups from low-grade masse-cuites, since it is very necessary to obtain a quick and reliable analysis of these impure and concentrated syrups; and then if these syrups give favourable results the purer and clearer syrups would of course be easy enough to deal with.

The following table gives the results of the first 25 analyses taken, not one of which was omitted; column 1 gives the polarization, columns 2, 3, 4 the Brix degrees (official dilution method), the true

dry substance (by desiccation), the refractometric dry substance (found from the 50% solution which served for polarization); columns 5, 6, 7 the quotient of purity calculated from the polarization and the values of 2, 3, 4; columns 8 and 9, the difference between the true dry substance and that obtained from the Brix degrees, and by the refractometer; columns 10 and 11, the difference between the quotient of purity calculated from the true dry substance and that obtained from the Brix degrees, and by the refractometer. The table is arranged to show the increasing values in the last column.

Number.	Polarization.	Dry Substance.			Quotient of Purity.			Difference between true dry substance and that from		Difference between true purity and that from	
		By Brix.	True.	By Refract.	By Brix.	True.	By Refract.	Degrees Brix.	Refract.	Degree Brix	Refract.
	1	2	3	4	5	6	7	8	9	10	11
1	65·0	93·20	91·90	92·00	69·7	70·7	70·7	− 1·30	− 0·10	+ 1·0	0
2	64·0	92·80	91·90	92·00	68·9	69·6	69·6	− 0·90	− 0·10	+ 0·7	0
3	61·2	92·60	90·93	91·00	66·1	67·3	67·3	− 1·67	− 0·07	+ 1·2	0
4	59·6	91·20	90·13	90·10	65·2	66·1	66·1	− 1·07	+ 0·03	+ 0·9	0
5	60·0	90·40	89·28	89·40	66·3	67·2	67·1	− 1·12	− 0·12	+ 0·9	+ 0·1
6	61·6	92·00	90·80	91·00	66·9	67·8	67·7	− 1·20	− 0·20	+ 0·9	+ 0·1
7	59·6	90·00	88·40	88·60	66·2	67·4	67·3	− 1·60	− 0·20	+ 1·2	+ 0·1
8	61·0	92·20	91·44	91·20	66·2	66·7	66·8	− 0·76	+ 0·24	+ 0·5	− 0·1
9	61·4	90·60	89·50	89·40	67·7	68·6	68·7	− 1·10	+ 0·10	+ 0·9	− 0·1
10	60·2	90·40	89·98	89·80	66·6	66·9	67·0	− 0·42	+ 0·18	+ 0·3	− 0·1
11	60·8	92·00	90·60	90·80	66·0	67·1	67·0	− 0·40	− 0·20	+ 0·9	+ 0·1
12	58·8	89·30	88·36	88·30	65·3	66·5	66·6	− 0·94	+ 0·06	+ 0·8	− 0·1
13	58·6	91·80	90·78	90·60	63·8	64·6	64·7	− 1·02	+ 0·18	+ 1·2	− 0·1
14	59·6	91·40	90·65	20·50	65·1	65·7	65·8	− 0·75	+ 0·15	+ 0·6	− 0·1
15	60·6	90·80	90·14	90·00	66·7	67·2	67·4	− 0·66	+ 0·14	+ 0·5	− 0·2
16	65·4	93·20	92·44	92·20	70·2	70·7	70·9	− 0·78	+ 0·24	+ 0·5	− 0·2
17	59·8	92·00	91·28	91·00	65·0	65·5	65·7	− 0·72	+ 0·28	+ 0·5	− 0·2
18	63·4	92·30	91·33	91·00	68·7	69·4	69·6	− 0·97	+ 0·33	+ 0·7	− 0·2
19	59·0	92·60	91·00	91·00	64·1	64·6	64·8	− 0·60	+ 0·40	+ 0·5	− 0·2
20	59·0	91·60	90·30	90·00	64·3	65·3	65·5	− 1·24	+ 0·36	+ 1·0	− 0·2
21	65·8	93·00	92·46	92·20	70·8	71·2	71·4	− 0·54	+ 0·24	+ 0·4	− 0·2
22	61·0	93·00	92·00	91·50	65·6	66·3	66·6	− 1·00	+ 0·50	+ 0·7	− 0·3
23	64·0	93·20	92·03	91·60	68·7	69·5	69·8	− 1·17	+ 0·43	+ 0·8	− 0·3
24	56·4	90·80	89·84	89·40	62·1	62·7	63·1	− 0·96	+ 0·44	+ 0·6	− 0·4
25	59·0	90·00	89·48	89·00	65·5	65·9	66·3	− 0·48	+ 0·48	+ 0·4	− 0·4

It will be observed that the dry substance as calculated by the refractometer, apart from a few instances where lack of practice affected the result, compares very favourably with the "true" figure and as regards practical application leaves nothing to be desired; and the same applies to the corresponding quotients of purity. The differences amount in four cases to 0, in ten cases to $\pm 0{\cdot}1\%$, in seven cases to $\pm 0{\cdot}2\%$, in two to $-0{\cdot}3\%$, and in two cases to $-0{\cdot}4\%$, none of which however appear to be outside the limits of practical error.

These results are very encouraging and make it desirable that in the next campaign throughout the beet sugar industry the refractometer be given as extensive trial as possible, and that the results may soon be available for public information; occasions for the employment of this instrument in the raw sugar factories, refineries, seed nurseries, &c., are many and various, and there is every prospect that great progress will be made.

It may be added that the manipulation of this instrument is easy to learn, and full instructions with illustrations accompany every instrument sent out.—(Abridged from the *Deutsche Zuckerindustrie.*)

THE WEST INDIAN AGRICULTURAL CONFERENCE, 1908.

The West Indian Agricultural Conference of 1908 met at Barbados on January 14th last, under the presidency of Sir Daniel Morris, the Imperial Commissioner. The Governor of Barbados, Sir Gilbert T. Carter, K.C.M.G., opened the proceedings, and there was a large and representative attendance, which included representatives for the Canadian Reciprocity Conference.

The President, after a few introductory remarks, began his Address with a survey of the sugar industry. He said:—

"The prospects of the sugar industry, from an agricultural point of view, are not unpromising. Owing to the prevalence of drought, the sugar crop in British Guiana is estimated at from 16 to 20% below the average. At Trinidad, the prospects of the crop are regarded as favourable. At Barbados, a moderate crop is anticipated, as also at Antigua and St. Kitt's.

"The quantity of sugar exported from the West Indies and British Guiana in 1906 was 254,118 tons, of the value of £2,157,147. Taking also the value of the molasses and rum, the total value of the exports of cane products was £2,626,914. The following are the quantities (in tons) of sugar exported from each colony, viz.: British Guiana, 114,951; Barbados, 50,630; Trinidad, 45,004; Leeward Islands, 24,000; Jamaica, 11,934; Windward Islands, 6,028.

"It will be observed that British Guiana supplies about 45% of the total exports of sugar from these colonies. At Jamaica, the average value of the exports of sugar and rum during the last five years is £245,170.

"It will be admitted that, in spite of the many discouraging circumstances that have operated against the success of the sugar industry, it still remains the chief mainstay of the prosperity of British Guiana, Barbados, Antigua, and St. Kitt's. Its failure would also largely affect the prosperity of Trinidad and Jamaica.

"The chief concern at the present moment is in regard to finding a reliable market for sugar products. During the last three or four years, the Dominion of Canada, by means of the preference offered to Great Britain and her colonies, has afforded a favourable market for West Indian sugar and molasses. It is estimated that about 79% of the total sugar consumed in Canada, for the year ended June 30th last, was received direct from the West Indies. The following, taken from Canadian returns, illustrates the value of the sugar and molasses imported into Canada, during the years mentioned, from the British West Indies and British Guiana:—

Articles.	1902.		1904.		1906.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons.	£	Tons.	£	Tons.	£
Sugar	21,467	183,899	139,830	1,067,149	162,346	4,416,965
	Gallons.		Gallons.		Gallons.	
Molasses and Syrups	2,696,601	95,731	2,554,291	113,844	4,141,177	155,901
Total Values....	....	279,630	....	1,180,993	....	1,572,866

"The results of the experiments that have been carried on in the principal sugar colonies in raising varieties of seedling canes less susceptible to disease, and yielding a larger amount of sugar, are proving of increased value. Larger areas are being planted year by year with seedling canes, and the more enterprising members of the planting community are convinced that seedling canes, selected with due regard to local circumstances, are proving more remunerative than the old varieties.

"The work in this direction, it is admitted, is only in the initial stages. There are still more promising seedling canes under experimental trial, and it is not improbable that in the near future, seedling canes capable of resisting disease, while, at the same time, yielding high percentages of sugar, will be generally cultivated in these colonies.

"As some indication of the value attached in other countries to seedling canes raised in the West Indies I would mention the Demerara canes D. 74 and D. 95, which are being widely cultivated in Louisiana and regarded as superior to any of the canes hitherto in cultivation in that part of the world.

"According to the report on the Lousiana Agricultural Experiment Station for 1906, seedling canes D. 74 and D. 95 have again maintained their superiority over the home canes, not only at the stations but throughout the State, the result being a large extension of the area being planted in this cane this year. This applies particularly to cane D. 74, which is highly commended by practically all planters.

"In British Guiana, reports issued by Professor Harrison show that the total area under cultivation with varieties of sugar cane other than Bourbon is about 30,000 acres, as compared with 15,000 acres in 1905-6, and 10,000 acres in 1903-4. 'The most notable increases of area under individual canes are those of D. 625, from 3,357 to 6,600 acres, and of B. 208, from 3,125 to 4,687 acres, or about 100% and and 50% respectively. The seedlings D. 145 and the two above-mentioned have, during the season, maintained their superiority to the Bourbon as sugar producers.'

"In a recent report Professor Harrison states: 'There can be no doubt that it is advisable for cane farmers on the coast lands to plant either D. 109, D. 145, D. 625, or B. 147 in place of the Bourbon; whereas farmers on the lighter loamy lands should try D. 145 or B. 208.'

"The records obtained and published by the Board of Agriculture show that during the last five years new varieties of sugar cane had given, over large areas, mean results of 8, 10, 22, and 35% higher than the mean returns from the Bourbon cane.

"The Sugar Cane Experiments Committee of the Board of Agriculture adds: 'It must be borne in mind that, in the case of many of the experiments, the varieties of seedling canes have been grown on land on which the latter cane does not flourish, while the Bourbon returns are, as a rule, from lands of average quality.'

"In addition, I would mention that on one estate in Demerara, with 4,404 acres under seedling canes and 1,570 acres under Bourbon canes, the seedling canes, taken together, averaged 26% better than Bourbon for the crop of 1907. Amongst the seedling varieties 2,403 acres were under B. 208, and this variety, during the crop of 1907, yielded 40% more sugar than the Bourbon cane.

"In the paper read by Mr. Bovell at the Jamaica Conference (*West Indian Bulletin*, Vol. VIII., p. 78), it was stated that more profit was derived from the cultivation of the Barbados seedling canes, grown on the above estate during the four years 1903-6, than would cover the cost of the sugar cane experiments at Barbados since they were inaugurated in 1884.

"In Barbados itself, on some few estates, no other canes are planted except seedlings. On others, appreciable portions are planted with seedlings of various varieties.

"In one instance, recorded by Mr. Laurie Pile at a meeting of the Agricultural Society at Barbados, in December, 1906, in reference to cane B. 376, 58 acres gave an average yield of 29½ tons of cane per acre, and the average yield in commercial sugar was at the rate of 2·95 tons per acre. Another instance is referred to by Mr. Bovell (*West Indian Bulletin*, Vol. VIII., p. 76) as follows:—'The owner of Carrington plantation was good enough to give me the average returns obtained on that estate from the White Transparent and B. 147 for the past four years, *i.e.*, 1903-6 inclusive. For that period there were practically about 200 acres of plants and ratoons of each variety grown each year. During that time the B. 147 gave, on the average, 398 lbs. of sugar more per acre than the White Transparent. This would, in round numbers, amount to about 160 short tons of sugar for the four years. At £9 per ton for the sugar and its molasses, the gross value would be £1,440. Assuming that the cost of manufacture amounted to £200, there would remain £1,200 as the profit to the estate for the four years due to cane B. 147 being grown in preference to White Transparent.'

"In a report presented by the Committee of the Barbados Agricultural Society, it is stated that 'the Sugar Experiments carried on at Barbados during the last few years have been of great advantage to the cause of agriculture in the Colony, and it would be a great blow to the sugar industry if they should be obliged to be discontinued, as there is every reasonable hope that even better results may be arrived at in the near future. These experiments cannot be carried on in their fulness without the help of the Imperial Department of Agriculture, which has extended them to an enormous degree and with a success which has been a benefit, not only to this island, but to the whole sugar world.'

"In the Leeward Islands the situation in regard to seedling canes is briefly summarized as follows:—At Antigua, up to about the year 1896, the Bourbon cane was practically the only variety under cultivation. This was so severely attacked by disease that the sugar crop was suddenly reduced to one-half the average production. The first introduction to replace the Bourbon cane was the White Transparent. For the crop of 1908 returns from 74 estates, or practically the whole of the sugar crop of Antigua, show that out of 9,811 acres under canes, 2,578 acres, or 26%, were occupied by improved varieties other than White Transparent. The Bourbon cane occupied only 190 acres. Returns from St. Kitt's for the crop of 1908 show that on 43 estates, or practically the whole of the sugar area, 5,314 acres out of a total of 7,500 acres, or 71% of the canes under cultivation, were newer varieties, *i.e.*, introduced since 1896.

"Dr. Watts explains that this large proportion of new varieties in St. Kitt's is due to the fact that the White Transparent, brought from Jamaica, to replace the Bourbon cane, was not found to exhibit in St. Kitt's that immunity from disease that it had shown elsewhere, and a more resistant cane was consequently looked for. This was found in B. 147—a cane, raised by Mr. Bovell, that was first brought to the notice of West Indian cane planters in 1899, through the agency of the then newly constituted Imperial Department of Agriculture.

"Dr. Watts adds: 'If we take the exports of sugar from Antigua and St. Kitt's at, very approximately, 25,000 tons, worth £200,000, and assume that the industry has only been benefited to the extent of 10 per cent. (an amount which will seem moderate to those who experienced the ravages of disease), this would give the very rough approximation of £20,000 a year as the value of the introduction of new varieties of canes—a sum in excess of that spent in maintaining the Imperial Department of Agriculture in its entirety. It is right and desirable that commutations of this kind, even though of the rough character here given, should be made in order to bring home to those interested the magnitude of the interests involved.'

"A summary of the results obtained in connection with the working of the central factory scheme at Antigua during the last three years will be presented by Dr. Watts. One striking feature is that out of 6,000 tons of crystals shipped from the island, nearly 2,500 tons represent the gain due to improved methods of crushing and manufacture of crystals. At Barbados, the Central Factory idea is beginning to take root. Two estates are being fitted with improved machinery with this object in view."

The regular business of the Conference was proceeded with on the following days. In the Sugar Section Professor Harrison, C.M.G., came first with a paper, which reviewed the work that had been carried on in British Guiana up to the end of 1907 and submitted a limited number of his "Progress Report in Agricultural Experiments for 1906-7." It was stated that 30,000 acres were occupied in British Guiana with varieties other than the Bourbon and that a very considerable proportion of the total sugar area of the colony was being cultivated in new seedling varieties. In 1899, about 550 acres were occupied by new seedling varieties in the colony. The opinion was expressed "that there can be no doubt that it is advisable for cane farmers on the coast-lands to plant either D. 109, D. 145, D. 625, or B. 147 in place of the Bourbon, whilst farmers on the lighter river-lands should try D. 145 or B. 208.

Reference was also made to the experiments that had been commenced to inquire into the effects of long-continued manurings

of sugar-cane lands with sulphate of ammonia and with nitrate of soda, and whether better results would not be obtained by the substitution of one nitrogenous manure for the other. The results of the experiments show that the substitution of nitrate of soda on non-limed land for sulphate of ammonia, continuously applied for fourteen years, was attended by a reduction of the increased yield, due to the nitrogenous dressing, from 12·1 tons to 10·3 tons, whilst the substitution of sulphate of ammonia, for nitrate of soda on the nitrate fields, increased the yield from 8·6 tons to 9·2 tons per acre. On limed soils, the substitution of nitrate of soda for sulphate of ammonia reduced the yields due to nitrogenous manuring from 11·8 tons to 8 tons per acre, whilst the change of sulphate of ammonia for nitrate of soda on the nitrate plots practically did not affect the yield. These are the results of only one series of experiments, but the apparent ill-effects of long-continued nitrogenous manurings were far more noticeable when nitrate of soda had been continuously used than where sulphate of ammonia had been, and indicated that on very heavy clay soils, under tropical meteorological conditions, the de-flocculation caused by long-continued dressings of nitrate of soda is likely to prove more injurious to the soil than is the souring action of sulphate of ammonia. The results also suggest that the injurious effects of nitrate of soda are more marked on limed land than on not-limed land, probably due to the liberation of free alkali in the soils during the de-flocculation caused by the nitrate of soda. Where soils, especially on the lighter lands of the colony, have been manured continuously for from thirty to fifty years with sulphate of ammonia, its souring action may have become marked, and decreases in yields may have resulted therefrom. A cure for sourness lies in an application of lime and not solely in changing the use of sulphate of ammonia to one of nitrate of soda. Manurial experiments with phosphates showed results that confirm the conclusion arrived at, that if a heavy clay soil in British Guiana yields more than ·008% of phosphoric acid to 1% citric acid solution under conditions of continuous shaking for five hours, manuring with phosphates in all probability will not produce commensurately increased yields of sugar cane. Until recently, large quantities of slag phosphates were yearly imported, but now, as the result of fourteen years' field experiments, the planter is able by submitting a properly drawn sample of the soil, to which he contemplates applying slag phosphates, for analysis, to decide as to the advisability of such an application. Considerable economy has ensued from the adoption of this course, and this conclusion is an important one for the guidance of planters in British Guiana. Seedling canes have also been produced from arrows of the more promising varieties. At present, in addition to the seedlings obtained in 1904, 1905, and 1906, there are 335 varieties of canes in cultivation on the Experimental Fields, of which 143 kinds are being experimented with on fair sized plots.

Hon. Francis Watts, adverting to the point brought forward by Professor Harrison in connection with the acidity of the subsoil, said it was a matter which was deserving of further investigation. In Antigua there were large areas where saline water existed, which he believed was of a different character and brought about by different agencies than those referred to by Professor Harrison. Subsoil drainage he thought for Antigua impossible.

Hon. B. Howell Jones, speaking as a practical planter, pointed out the necessity of planters co-operating with scientific men in carrying out experiments with new varieties of sugar cane, if the sugar industry of their colony was to reap the full benefit. One thing which the experiments conducted in British Guiana had taught the planters there was this: that they should be cautious in stating that a cane of a certain variety was so much superior to a cane of another variety. A cane which suited one locality might prove a failure in another—conditions of soil and climate had always to be taken into consideration.

In closing the discussion, the President observed that it was always to be borne in mind in connection with the experiments carried on at Botanical Gardens in British Guiana, that the soils were remarkably stiff, and the conditions existing there were such as possibly existed nowhere else in the West Indies. There were also great variations in tho soil and conditions in different districts in British Guiana. Hence, it should not be a matter of surprise if a certain cano proved a failure in one locality and was regarded as the best variety in another. That being so, he did not think that Barbados, British Guiana, Jamaica, or Antigua were in any way prejudiced because a cane that gave good results in one colony did not yield high returns when planted in another colony.

Professor J. P. d' Albuquerque (Barbados) followed, on behalf of Mr. J. R. Bovell and himself, with a paper dealing with the results of the experiments with sugar cane carried on at Barbados to the end of the season 1905-7. He referred to the pamphlet containing a summary of the results obtained on the experiments with varieties which had recently been issued by the Imperial Department of Agriculture, and which was in the hands of members of the Conference. Further and successful progress had been made in the direction of cross fertilization, with the object of producing seedling canes whose parentage (both male and female) was distinctly known, and an extended series of experiments has been inaugurated by Mr. F. A. Stockdale, for the purpose of raising new varieties by hybridization. The experiments with seedling canes at Barbados showed that many gave indicated yields greatly superior to those given by White Transparent, the standard cane, but it was stated that although it was not anticipated that the same results would be shown by these canes when planted over larger areas, yet it was hoped that a large number

of them would maintain a practical advantage in yield over that variety. By these experiments the planters are enabled to decide what varieties are best suited to their different climatic conditions, but it must be left to the planters themselves to ascertain experimentally what canes they will plant upon a large scale. The fact that 8000 acres are planted in seedlings in Barbados indicates that the planters are fully aware of the good qualities of these newer varieties. It is also interesting to note that many Barbados-raised seedlings have done exceptionally well outside the island.

The manurial experiments indicate that a normal application of farmyard manure plus nitrogenous artificials is to be recommended, and that such manurial treatment gives better results than those given by additional applications of farmyard manure of the normal quantity applied on the estates. The application of phosphatic and potassic manures had given varied results, and, in some instances, notable increases of yield were recorded.

Mr. Cowley (Antigua) mentioned that the manurial experiments at Barbados showed that artificials added to farmyard manure gave increased yields, while the experiments at Antigua gave results which indicated that a normal application of farmyard manure was quite sufficient for the successful growth of plant canes. Such differences as these indicated the necessity of having established reliable experiments in the different islands, and the results obtained showed the necessity of having a well organized Agricultural Department in their midst. Information was also asked for in reference to the difference of results obtained from seedling canes when planted at different periods of the year, and to the length of maturity of several of these canes.

(*To be continued.*)

THE USE OF COMPRESSED AIR IN THE CRYSTALLIZATION AND MALAXAGE OF CANE SYRUPS IN BRAZIL.

The crystallization of syrups with the object of obtaining in a single strike the whole of the sugar contained in the juice has for some years past formed the subject of many an experiment in beet factories; these have resulted in the adoption of various types of malaxeurs all based on the principle of a rational digestion of the sugar crystals produced in the vacuum pan.

The learned labours of Horsin Déon, Pellet, Claassen, &c., have shed light upon the complex problem of the crystallization and supersaturation of average sugar liquors in impure liquids and at the present moment the various actions have been mathematically fixed

and presented in the form of laws and have given rise to numerous systems of malaxeurs which all profess to confirm the theoretical suppositions.

These malaxeurs, whatever their precise design, consist as a rule of a horizontal cylindrical or semi-cylindrical receptacle either open or closed, with or without double sides, working either at atmospheric pressure or else in a vacuum, traversed through its centre by a shaft fitted with arms, or by a helical frame of suitable design and either solid or hollow, and having for its object the bringing of the sugar crystals into continuous and intimate contact with the liquid which contains them under a carefully regulated temperature until this liquid is completely desugarized.

Now there exists a process of crystallization and malaxage of syrups which, old though it is, does not appear to have received sufficient attention in sugar factories, especially those dealing with cane sugar, although many patents have been taken out on the subject. We refer to the system of malaxage by means of compressed air which while principally employed for runnings is nevertheless, as we propose to show, well adapted for working first jet syrups.

For the purpose, the runnings are boiled to string more or less fine according to the quality of the product and emptied into an open tank fitted with perforated coils of various shapes and fittings: these convey a supply of air at certain determined pressures which issuing forth produces an even and continuous movement of the mass and results in the cooling and ultimate crystallization of the whole.

The operation lasts from 20 to 60 hours according to the type of apparatus and the nature of the products treated, and produces a highly crystallized sugar, which centrifugals with ease and yields a molasses of normal purity.

But, as we said, this process despite its simplicity is not extensively employed in the sugar industry and this is accounted for, in our opinion, by the fact that the procedure in use where it is actually adopted is by no means a ideal one; and also owing to a prevalent belief that glucose is formed from the action of the compressed air on the impure syrups.

This formation of glucose appears difficult enough to explain in a beet sucrerie where alkaline products are under constant treatment and where moreover the formation of sulphuric acid from the action of the oxygen in the air is only possible on the supposition that sulphurous acid exists in a free state in the runnings—a difficult hypothesis to substantiate inasmuch as there is an excess of lime in the product.

It is not however the same case in a cane sucrerie where the products are brought to a strong acid reaction and sulphurous acid is used in large doses. Under such conditions, the production of the

glucose can be explained on the supposition that the sulphurous acid contained in the runnings in a free state is transformed into sulphuric acid which at the prevailing temperature of about 80 degrees may possibly invert a certain proportion of the saccharose.

Anyhow we have made a determined trial in Brazil of a system of malaxage of the runnings by means of compressed air; and the results obtained up to date though achieved by the aid of somewhat obsolete apparatus have been as follows:—

Not only has there been no formation of glucose at all during the malaxage but what is more under the chemical action of the air a remarkable degree of epuration has been achieved as shown by the abundant viscous froth which floated on the surface of the liquid.

The results are given in the following table containing a resumé of the analyses carried out by us on first and second jet runnings treated by this process. The second jet runnings came from canes having a large content of glucose.

Type of Running.	Density at 15° C.		Glucose Per cent. kg.		Apparent Purity.		Glucose Coefficient.	
	Before	After	Before	After	Before	After	Before	After
	Malaxage.		Malaxage.		alaxage.		Malaxage.	
1st jet ..	1·458	1·470	16·94	16·12	67·0	71·3	29·9	25·5
1st jet ..	1·460	1·470	17·84	17·24	66·0	68·9	31·0	28·3
1st jet ..	1·472	1·484	18·20	17·94	69·0	69·6	29·7	28·0
Mixed ..	1·476	1·484	18·20	18·00	60·8	61·5	33·4	32·8
2nd jet. .	1·456	1·462	22·20	22·00	58·3	58·8	51·8	51·2

As seen in this table, the coefficient of purity denotes a high purification, while simultaneously the reduction in the glucose coefficient proves the disappearance of a certain amount of glucose during malaxage; all of which goes to prove the existence of a purifying action on the part of the air, quite apart from its purely mechanical operation.

Moreover, if we examine the froth formed during malaxage we find it is much more impure and more charged with glucose than was the running from which it came; this also confirms the belief in the purifying process alluded to.

The results were as below:—

Nature of the running .. 1st jet with $\frac{1}{5}$ of 2nd jet added.
Duration of malaxage .. .. 14 hours.
Melting temperature .. .. 80° C.
Centrifugalling temperature .. .. 40° C.

	Before Malaxage.	After Malaxage.	Froth.
Density at 15° C.	1·460 ..	1·470 ..	....
Reducing power % kil.	17·84 ..	17·24 ..	18·50
Apparent purity	66·6 ..	68·9 ..	64·4
Glucose coefficient	31·0 ..	28·3 ..	33·2

This purification, as shown in the above analyses was so thorough that it occurred to us, in order to combine practice with theory, to let malaxage take place without allowing the scums rising to the surface to froth; but under these conditions the centrifugalling became exceedingly difficult owing to the great viscosity of the mass.

The conclusion to be drawn then is that the compressed air system of malaxage, if only from its reduced size and the simplicity of its working, possesses real advantages; moreover, these advantages are rendered of increased interest on account of the strong purifying action which takes place during the operation, a purification entirely due to the action of the compressed air on the organic matter contained in the runnings.

Multiple Effet Crystallizers.

One of the reasons for the alleged inferiority of the compressed air malaxage is the fact already stated, that the process can only be applied to runnings, which products tend to disappear with the advent of the process of crystallization in motion. Moreover this system, in cane sucreries in particular, did not till lately permit any ideal basis for digestion of the products under treatment, thus rendering the process very uncertain, as could be seen from an inspection of our first table.

The usines in Brazil which go in for this system of malaxage boil their runnings to string without taking account of their purity, and cool them without heating in open tanks fitted with perforated coils, where they are subjected to the action of compressed air at some haphazard pressure and temperature.

It is evident that under such conditions the malaxage can only give poor results, for it is a fact one cannot lay too much stress on that purification of the runnings by means of compressed air, and thereby their output, depends intimately on the temperature of the mass under treatment, and this varies according to the purity of the product.

Now a distinguished engineer, living in Sao Paulo, Mr. F. Dumoulin, who is familiar with the routine of a tropical sucrerie, lately applied for a patent, incorporating the principles enumerated above, of an apparatus intended for the crystallization of sugar juices under the action of compressed air, and which he has designated a *continuous multiple effet crystallizer*.

This apparatus (patented August 10th, 1907, No. 5045,) employs, according to the published specification, "compressed dehydrated air at a determined pressure and temperature with the object of continuously crystallizing syrups and runnings of sugar juices whatever their origin."

In its essential principles, the apparatus comprises a battery of several receptacles of a suitable shape and arranged to form a cascade. The first tank, called the heating crystallizer, receives the syrup from the vacuum pan boiled to a water content proportional to its purity. This receptacle is fitted with steam coils and a perforated tube for the blowing up with hot dehydrated compressed air. The two following tanks, called *alimentateurs* or digestors, are each fitted with a perforated air pipe. The last tank, called a " cooler," likewise possesses an air blower, but in this case the air is supplied quite cold.

The aeration is accomplished by means of an air pump which takes in the surrounding air and forces it through a " dehydrator " whence it passes into a pressure regulator. From here it is forced through a heater to raise its temperature to the required degree (except in the one case above referred to where cold air is used) and is then distributed amongst the various tanks.

The working of the apparatus is as follows:—

The syrup or running evaporated in the vacuum pan to string proof and more or less fine, having a water-content in relation to the purity, is passed into the "heating crystallizer" where it is brought to a temperature varying between 90° and 100° C. This accomplished, the hot compressed air is admitted so as to produce a malaxage neither too strong or too feeble and the aeration is continued till the first crystals are obtained, an operation which lasts as a rule for an hour.

Thereupon the mass is passed into the first "alimentateur" which is filled just half-full and then aeration begins again and leads to the frothing of the scums which rise to the surface. Meanwhile the first vessel has been refilled and the operations repeated.

As a result of another transfer between the two vessels, the first "alimentateur" gets full, whereupon its contents are emptied into the second " alimentateur," where the same cycle of operations is gone through till when this last vessel is full and the scums are all segregated, the mass is transferred to the " cooler."

Here the object is to bring the mass down to the most suitable temperature for centrifugalling, the malaxage is therefore continued with the aid of cold air till the vessel is full; then if all the operations have been properly carried out, the mass is ready for curing.

The malaxage as described takes from 20 to 40 hours to complete, according to the quality of the products treated, and it enables the centrifugals to yield a perfectly homogeneous sugar.

To sum up, the compressed air system of crystallizing syrup and runnings in cane factories, as carried out in the apparatus described above, is an ideal one, for it permits :—

1. The preliminary heating up of the sugar liquid, an important point in view of the size of grain.

2. The continuous digestion of the product.

3. The malaxage of the mass accompanied by a gradual fall in the temperature relative to the maximum degree of desugarizing.

4. Centrifugalling at a temperature to suit the viscosity of the product.

In conclusion it may be said that without expecting of the apparatus more than it can give we are yet justified in claiming that this system of malaxage will give highly satisfactory results, especially as the operator can whatever the market conditions produce a type of sugar which always shows the same properties, both in the size as in the colour of the crystals.

What is more, the epuration of the products by means of the compressed air is greatly improved from the fact that we have full control of the air supply and can introduce it at any desired temperature. In fact this epuration is absolutely adjustable to the temperature existing in the mass under treatment.

We might here refer to a work published in 1906 by Mr. S. Peck, of Hawaii, on Hawaiian exhausted molasses in which the author draws the attention of the reader to the scums obtained by heating up the runnings previous to centrifugalling and suggests the possibility of improving the product by such scumming. This view is fully confirmed in the working of the apparatus described in the present paper.—(Translated from the *Journal des Fabricants de Sucre.*)

A new company, the Formosa Sugar Development Co., Ltd., has recently been formed in London to acquire and work the sugar mill and factory known as Hing Hoat Seito Kaisha, San Kan Ton, South Formosa, formerly belonging to Messrs. Bain & Co. The capital is fixed at £80,000 in 60,000 preference shares of £1 each, and 40,000 ordinary shares of 10s.

There has been a large increase in the imports of Java sugar into India of late. For the eight months ending November 30th last, the amount was 224,700 tons, as against 134,500 tons in the corresponding period of 1906. Java seems destined to drive European competitors out of the Indian market, and even Mauritius is suffering from her rivalry.

QUOTATIONS FOR 96° CENTRIFUGAL SUGAR.

The following table, for which we are indebted to Messrs. Willett & Gray's Circular, will be found of use for general reference. For a table of equivalents we must refer our readers to the January, 1907, *International Sugar Journal,* where the purity of 88 beet and 96 polarization sugar is shown.

NET CASH.—CENTS PER POUND.

Date.		1907.	1906.	1905.	1904.	1903.	1902.	1901.	1900.	1899.	1898.
January	2	3·56	3·625	4·875	3·47	3·875	3·625	4·375	4·25	4·31	4·18
	3	3·56	3·625	4·875	3·47	3·875	3·56	4·375	4·25	4·31	4·18
	10	3·56	3·75	5·06	3·35	3·875	3·375	4·375	4·31	4·31	4·18
	17	3·50	3·625	5·24	3·31	3·81	3·50	4·375	4·375	4·25	4·06
	24	3·48	3·56	5·25	3·31	3·69	3·69	4·25	4·375	4·25	4·06
	31	3·48	3·50	5·25	3·35	3·625	3·69	4·25	4·44	4·31	4·06
February	7	3·42	3·36	4·94	3·35	3·69	3·625	4·25	4·50	4·31	4·18
	14	3·42	3·36	4·94	3·35	3·75	3·625	4·25	4·44	4·31	4·18
	21	3·38	3·36	5·06	3·375	3·75	3·625	4·22	4·44	4·375	4·18
	28	3·42	3·39	5·125	3·44	3·78	3·375	4·19	4·375	4·375	4·18
March	7	3·51	3·44	5·06	3·44	3·75	3·40	4·06	4·31	4·41	4·125
	14	3·50	3·52	4·88	3·50	3·72	3·44	4·00	4·375	4·375	4·06
	21	3·51	3·56	4·84	3·60	3·625	3·625	4·03	4·44	4·375	4·00
	28	3·58	3·50	4·81	3·67	3·56	3·625	4·03	4·44	4·44	4·125
April	4	3·61	3·55	4·94	3·67	3·50	3·375	4·06	4·375	4·50	4·125
	11	3·735	3·48	4·88	3·61	3·59	3·375	4·10	4·50	4·56	4·125
	18	3·765	3·42	4·72	3·54	3·69	3·44	4·19	4·44	4·625	4·125
	25	3·73	3·375	4·625	3·70	3·69	3·50	4·19	4·42	4·625	4·25
May	2	3·765	3·48	4·625	3·73	3·69	3·50	4·25	4·47	4·75	4·18
	9	3·83	3·48	4·50	3·75	3·69	3·50	4·28	4·44	4·625	4·18
	16	3·86	3·42	4·34	3·88	3·69	3·44	4·28	4·47	4·625	4·25
	23	3·92	3·42	4·375	3·95	3·625	3·44	4·28	4·50	4·625	4·31
	29	3·90	3·45	4·375	3·95	3·59	3·44	4·25	4·56	4·625	4·31
June	6	3·84	3·47	4·375	3·875	3·59	3·50	4·25	4·625	4·69	4·31
	13	3·73	3·50	4·25	3·84	3·59	3·50	4·25	4·625	4·69	4·31
	20	3·71	3·50	4·31	3·94	3·56	3·31	4·25	4·625	4·625	4·25
	27	3·875	3·61	4·25	3·94	3·56	3·375	4·25	4·69	4·50	4·25
July	3	3·835	3·75	4·19	3·94	3·56	3·31	4·25	4·75	4·50	4·125
	11	3·835	3·72	4·00	3·94	3·69	3·31	4·19	4·75	4·44	4·125
	18	3·835	3·72	4·00	3·94	3·69	3·375	4·15	4·81	4·375	4·125
	25	3·94	3·75	4·06	3·94	3·66	3·375	4·19	4·875	4·50	4·125
August	1	3·94	3·80	4·06	4·06	3·72	3·40	4·16	4·875	4·56	4·125
	8	3·94	3·875	4·125	4·125	3·72	3·40	4·125	4·81	4·56	4·25
	15	3·89	3·875	4·125	4·25	3·81	3·375	4·00	4·875	4·50	4·25
	22	3·89	3·94	4·00	4·25	3·875	3·375	4·00	4·875	4·50	4·31
	29	3·92	4·00	4·00	4·31	3·875	3·41	3·81	4·875	4·50	4·375
Sept.	5	3·92	4·00	4·00	4·31	3·875	3·50	3·75	4·94	4·44	4·375
	12	3·95	4·09	3·875	4·31	3·875	3·47	3·75	5·00	4·375	4·375
	19	3·95	4·125	3·625	4·25	3·91	3·50	3·75	5·00	4·375	4·31
	26	3·95	4·06	3·69	4·31	3·91	3·50	3·75	5·00	4·31	4·31
October	3	3·95	4·00	3·61	4·29	3·85	3·50	3·75	4·91	4·31	4·21
	10	3·95	4·00	3·625	4·25	3·875	3·56	3·75	4·75	4·31	4·18
	17	3·90	4·00	3·58	4·25	3·875	3·625	3·75	4·75	4·31	4·25
	24	3·90	4·00	3·50	4·22	3·875	3·625	3·81	4·625	4·31	4·31
	31	3·90	3·88	3·50	4·41	3·81	3·625	3·81	4·375	4·31	4·31
Nov.	7	3·90	3·81	3·44	4·41	3·81	3·69	3·75	4·375	4·25	4·31
	14	3·80	3·81	3·44	4·625	3·75	3·81	3·72	4·375	4·25	4·44
	21	3·70	3·81	3·55	4·75	3·75	3·875	3·69	4·375	4·25	4·50
	27	3·625	3·84	3·56	4·75	3·69	3·94–4	3·75	4·375	4·25	4·44
Dec.	5	3·625	3·84	3·56	4·75	3·625	3·94	3·75	4·44	4·25	4·44
	12	3·85	3·875	3·625	4·875	3·625	3·94	3·75	4·41	4·25	4·44
	19	3·85	3·875	3·625	4·875	3·56	3·94	3·75	4·375	4·25	4·375
	26	3·85	3·58	3·625	4·375	3·47	3·875	3·66	4·375	4·25	4·31

CENTRIFUGALS.—Average price per pound for 1907, 3·756c.; 1906, 3·686c.; 1905, 4·278c.; 1904, 3·974c.; 1903, 3·72c.; 1902, 3·542c.; 1901, 4·047c.; 1900, 4,566c.; 1899, 4·419c.; 1898, 4·235c.

CONSULAR REPORTS.

Persia.

Bushire.—The most striking feature of the imports has been the very heavy influx of loaf sugar into the country. Both in 1904 and 1905 it was estimated at some £75,000; in 1906-07 it rose to the record figure of £131,353. There are three principal brands imported from Marseilles, Belgium and Hungary respectively.

Of the total amount mentioned above, £97,987 has been declared as French sugar, which commands the market northwards from Shiraz. It is both sweeter and more quickly soluble than the other kinds, and is for those reasons preferred by the bulk of the Persians. Nearly all loaf sugar brought for Persian consumption is in cones about 11 inches high, wrapped in dark blue paper, and with a round black label in the centre inscribed in gold. The cones are brought in cases and bags; to a large extent French sugar is in bags containing 24 loaves of 2 kilos. each, which constitutes a half donkey load, for the transport up-country on donkey back is about 10d. per cwt. cheaper than mule transport.

Here, again, the customs figures are misleading, for in spite of the considerable amounts to which British and Indian origins are assigned, it is improbable that any British or Indian sugars were actually imported. These items are in the one case due to the orders given by middlemen here on their agents in Bombay to put into the hands of warehousemen there, and in the other to transhipment of Belgian sugar in the United Kingdom. So also in the case of Germany's pseudo-import of £7359, it is almost entirely a case of shipments by German steamers of Belgian sugar.

At the beginning of 1906 an Austro-Hungarian brand was still in great repute in the coastal and southern regions of Persia, but no deliveries took place after April, when it was practically driven off the market by a Belgian sugar. Several characteristics served to commend the Belgian brand to the consumer of the littoral, who likes to stir his sugar long in his glass; it is far less quickly soluble in water than either the French or Hungarian sugars, and is not too sweet, but the principal attraction lies in its cheapness.

At the end of 1906 prices began to fall considerably in Persia, due partly to low rates in Europe but principally to the glutted state of the markets here. It is characteristic of the Persian merchant that he buys sugar without watching the tendency of the market. Throughout the year huge orders were given, and at one time all available space in the custom house was filled with bags of sugar. On a slight easing of the market in Shiraz in the month of May, 1906, a general scramble ensued to get sugar away from Bushire, and more orders went forward

to Europe, with the result that matters reverted to their former condition. Prices for the Belgian sugar in Bushire have varied from 4 krans (1s. 5d.) per mán ($7\frac{3}{4}$ lbs.) or 70 krans (£1 2s. 3d.) per case. In February, 1907, it stood at 62 krans per case; about March prices were down at 54 krans (£1) per case of about 18 Bushire máns (138 lbs. approximately). There is some probability that the Hungarian sugar will return to favour in the course of 1907-08; they have now quotations for 1·70 kilo. as well as 1·80 and 2 kilo. cones. Cones of 1·70 kilos. are generally 3d. to 4d. dearer per cwt. than 1·80 cones. In the past there have been attempts to introduce British-made sugar into Persia, but the manufacture did not accommodate himself to the market. Cube sugar will not pay in Persia, and cones should be in the dimensions mentioned above. Some effort should be made in the United Kingdom to quote cones at a price which will compete with foreign brands. No Russian sugar was imported throughout the year and very little Egyptian.

There are three principal brands of soft sugar imported: (1) Austro-Hungarian. The best liked, a very sweet sugar in clear, white, large crystals and packed in bags of 2 cwts. net. Its price in April, 1906, in Bushire was 2·90 krans (approximately 1s.) per $7\frac{3}{4}$ lbs. In May this fell, owing to large stocks on the market, to 2·70 krans (under 11d.). By March it had recovered slightly and rose to 3 krans as there was a certain scarcity up-country. (2) Also Austro-Hungarian in manufacture, but the crystals are not so large or so white as No. 1, and its price is about 5d. per cwt. cheaper, though that has not yet destroyed the established preference for No. 1. (3) First marks granulated. A German kind which is only appreciated in the coast districts. Very little has come in 1906-07; most of that entered as German being shipped from the depôt of Austro-Hungarian sugar in Hamburg. It is moist and yellow-tinged, almost dirty in colour, and not nearly so sweet as the crystal sugar. As in the case of loaf sugar the soft sugar assigned to India and the United Kingdom is probably almost entirely Austro-Hungarian crystals transhipped in the United Kingdom and Bombay. Formerly all Austro-Hungarian sugar was transhipped at Bombay; now it comes through London viâ Hamburg.

There is no reason why British refined crystals of equal quality, if put on the Persian market at a slightly lower rate than the Austro-Hungarian, should not command good business. No Russian soft sugar was imported throughout the year.

Kermanshah.—Imports during 1906-7:—

	India.		France.		Total.
	lbs.	£.	lbs.	£.	£.
Sugar, in loaf or candy ..	15,005	1,319	1,773,328	143,495	144,814
,, powdered..	$111,395\frac{1}{2}$	8,081	....	....	8,081

Cuba.

Table showing the Total Area of Land in Cuba suitable for the Growing of Sugar Cane, and the actual Area under Cultivation.

Province.	Area. Total.	Area. Suitable for Growing Sugar Cane.	Percentage of Total Area.
	Acres.	Acres.	
Havana	1,774,080	1,543,450	87
Pinar del Rio	3,200,000	2,176,000	68
Matanzas	2,368,000	1,420,800	60
Santa Clara..	6,118,400	3,671,040	60
Camaguey..	6,720,000	2,889,600	43
Santiago	7,979,520	3,750,374	47
Total	28,160,000	15,451,264	..

Province.	Area under Sugar Cane Cultivation.	Percentage of Cultivated Cane Land to Land suitable for Cane Cultivation.	Percentage of Total Production of Sugar Cane.
	Acres.		
Havana	26,547	1·72	6
Pinar del Rio..	15,885	0·73	3½
Matanzas	118,352	8·33	26
Santa Clara	183,552	5	40
Camaguey	33,519	1·16	7
Santiago	79,508	2·12	17½
Total	457,363	..	100

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. Thompson, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; and 322, High Holborn, London.

ENGLISH.—Applications.

28531. J. Higginbottom, Liverpool. *Improvements in washing wheat, cereals, granular matter, sugar, minerals and ores, also fibrous matter and the like.* 28th December, 1907.

214. M. Hoff, London. *Improvements in or relating to the manufacture of sugar from starch substances.* (Complete specification.) 3rd January, 1908.

595. R. Mitchell, Glasgow. *Improvements in the rolls of sugar cane mills.* 10th January, 1908.

ABRIDGMENTS.

14764. H. DIAMANTI, Paris, and N. BEUF, Beaulieu (Aube). *Improvements in hydro extractors.* 26th June, 1907. This invention relates to a hydro extractor with continuous and adjustable output, applicable to all industries, and in particular to the artificial silk industry, characterized by a basket presenting a biconical wall, its bottom likewise conical receiving the material to be dried which is distributed by a pallet mechanism arranged at the orifice of an axial passage, through which this material is supplied to the apparatus, the discharge passage tangential to the cover of the apparatus being provided at its origin with an adjustable knife in the form of a plough share collecting the dried material which, under the impulsion given to it, traverses the inclined plane of the knife and escapes through the discharge passage.

25860. J. OST, Buenos Aires, Argentina. *Improved process of sugar purification and means or apparatus therefor.* 15th November, 1906. This invention relates to a process of sugar purification wherein porous substances are placed in such contact with crude sugar as to absorb syrup, characterised by the fact that the sugar crystals and the porous substances can be separated by a sieve or sifter which allows the crystals to pass but retains the porous substances and absorbed syrup.

GERMAN.—ABRIDGMENTS.

190614. CARL DRUMM, of Kaiserslautern. *Centrifugal for starch and other materials.* 8th January, 1907. In this apparatus there is a central part of the drum arranged between two fixed conical spiral ends in such a way that it can be drawn out.

192066. ALBERT GUNTHER, of Halle-on-Saale. *A constantly acting centrifugal, more particularly for sugar masse-cuite.* January 5th, 1907. In this centrifugal the material is conveyed during the operation into charging and distributing apparatus adjustable to different levels by means of a system of insertions divided in tiers by means of floors thrown against a semispherical drum casing, and discharged below.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of January, 1907 and 1908.

IMPORTS.

Raw Sugars.	Quantities. 1907. Cwts.	Quantities. 1908. Cwts.	Values. 1907. £	Values. 1908. £
Germany	1,009,555	765,539	455,421	377,417
Holland	21,743	8,936	8,609	4,555
Belgium	52,080	10,612	22,168	5,192
France	610	11,942	326	6,755
Austria-Hungary	110,104	76,090	49,346	38,645
Java	2	14,762	....	8,150
Philippine Islands	....	....	....	....
Cuba	....	....	..	....
Peru	58,908	34,899	26,605	15,859
Brazil	74,921	1,612	31,097	728
Argentine Republic	....	....	....	....
Mauritius	52,218	107,045	20,469	45,796
British East Indies	....	....	....	....
Straits Settlements	16,944	24,293	6,977	10,581
Br. W. Indies, Guiana, &c.	62,590	117,872	40,234	81,153
Other Countries	18,441	22,983	8,813	11,534
Total Raw Sugars	1,478,116	1,196,585	670,065	606,365
Refined Sugars.				
Germany	1,230,247	1,203,549	723,173	740,114
Holland	203,238	189,715	126,275	123,384
Belgium	19,280	26,173	11,864	15,779
France	47,991	58,170	28,749	36,242
Other Countries	13	6,976	7	4,278
Total Refined Sugars	1,500,769	1,484,583	890,068	919,797
Molasses	257,447	116,151	49,398	26,864
Total Imports	3,236,332	2,797,319	1,609,531	1,553,026

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	50	524	50	208
Norway	936	450	159	292
Denmark	8,528	8,502	4,436	4,715
Holland	6,969	4,256	4,492	2,965
Belgium	768	993	462	654
Portugal, Azores, &c.	2,343	364	1,371	260
Italy	1,794	1,250	980	718
Other Countries	23,350	14,414	16,760	10,892
	44,738	30,753	29,110	20,704
Foreign & Colonial Sugars				
Refined and Candy	647	924	514	720
Unrefined	3,068	2,975	1,642	1,909
Molasses	23	175	8	41
Total Exports	48,476	34,827	31,274	23,374

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1908. Tons.		1907. Tons.
Total Receipts Jan. 1st to February 13th	151,949	..	198,772
Receipts of Refined ,, ,, ...	125	..	160
Deliveries ,, ,, ...	157,569	..	192,652
Consumption (4 Ports, Exports deducted) since January 1st..	....	..	....
Importers' Stocks, February 12th ..	none	..	6,120
Total Stocks, February 19th	126,000	..	180,080
Stocks in Cuba, ,, ...	89,000	..	204,000
	1907.		1906.
Total Consumption for twelve months..	2,993,979	..	2,864,013

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1907 AND 1908.

(Tons of 2,240lbs.)	1907. Tons.		1908. Tons.
Exports	167,009	..	81,613
Stocks	165,365	..	55,079
	332,374	..	136,692
Local Consumption (1 month)	4,100	..	4,750
	336,474	..	141,442
Stock on 1st January (old crop)	....	..	9,318
Receipts at Ports up to January 31st.. ..	336,474	..	132,124

Havana, January 31st, 1908. J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR ONE MONTH, ENDING JANUARY 31ST, 1908.

SUGAR.	IMPORTS. 1906. Tons.	1907. Tons.	1908. Tons.	EXPORTS (Foreign). 1906. Tons.	1907. Tons.	1908. Tons.
Refined	70,857	75,038	74,229	56	32	46
Raw	82,936	73,906	59,829	516	153	149
Molasses	8,750	12,872	5,808	51	1	9
Total..........	162,543	161,816	139,866	623	186	204

	HOME CONSUMPTION. 1906. Tons.		1907. Tons.		1908. Tons.
Refined..	66,803	..	73,070	..	73,241
Refined (in Bond) in the United Kingdom	47,722	..	43,228	..	42,867
Raw	12,872	..	9,952	..	14,101
Molasses	9,485	..	10,961	..	8,201
Molasses, manufactured (in Bond) in U.K.	5,660	..	5,824	..	7,482
Total..............................	142,542	..	143,035	..	145,892
Less Exports of British Refined.....................	3,678	..	2,237	..	1,538
Total Home Consumption of Sugar	138,864	..	140,798	..	144,354

STOCKS OF SUGAR IN EUROPE AT UNEVEN DATES, FEB. 1ST TO 15TH, COMPARED WITH PREVIOUS YEARS.

IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	TOTAL 1908.
167	1350	618	965	229	3330

	1907.	1906.	1905.	1904.
Totals	3327 ..	3763 ..	2568 ..	3457

TWELVE MONTHS' CONSUMPTION OF SUGAR IN EUROPE FOR THREE YEARS, ENDING JANUARY 31ST, IN THOUSANDS OF TONS.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria-Hungary	Holland, Belgium, &c.	Total 1907-08.	Total 1906-07.	Total 1905-06.
1876	1164	659	540	203	4442	4432	3826

ESTIMATED CROP OF BEETROOT SUGAR ON THE CONTINENT OF EUROPE FOR THE CURRENT CAMPAIGN, COMPARED WITH THE ACTUAL CROP OF THE THREE PREVIOUS CAMPAIGNS.

(From Licht's Monthly Circular.)

	1907-1908. Tons.	1906-1907. Tons.	1905-1906. Tons.	1904-1905. Tons.
Germany	2,132,000 ..	2,238,000 ..	2,415,136 ..	1,598,164
Austria	1,440,000 ..	1,344,000 ..	1,509,870 ..	889,373
France	725,000 ..	756,000 ..	1,089,684 ..	622,422
Russia	1,410,000 ..	1,470,000 ..	968,000 ..	953,626
Belgium	235,000 ..	283,000 ..	328,770 ..	176,466
Holland	175,000 ..	181,000 ..	207,189 ..	136,551
Other Countries .	435,000 ..	445,000	415,000 ..	332,098
	6,552,000	6,717,000	6,933,649	4,708,587

THE

INTERNATIONAL

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☞ All communications to be addressed to the Editor, Office of "The Sugar Cane," Altrincham, near Manchester.

All Advertisements to be sent direct.

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The Editor will be glad to consider any MSS. sent to him for insertion in this Journal and will endeavour to return the same if unsuitable; but he cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTICE TO READERS.—If the Advertisement pages stick together, bang their edges on the table, when they should easily separate.

NOTES AND COMMENTS.

The Political Outlook.

We have not for some time past referred to the political situation at home, because there have not been till just lately any special indications that the party in office were meeting with more than normal opposition in the country. We are not concerned with the domestic differences of the two great parties in the United Kingdom, but we have all along had to show antagonism to the so-called Liberal party because, apart from their animosity towards the Sugar Convention, we considered that their attitude towards Imperial questions was utterly hostile to the welfare of the Empire at large. It is old history now how the present Government banged and barred the door in the face of the Colonies, to quote the expression one of their number employed. It was obvious that as long as they maintained that implacable attitude there was no hope that the Colonies in general, and the sugar ones in particular, could look forward to any prospect of preferential arrangements with the mother country, such as other States accord to their colonies. As far therefore as this question was concerned, the existence of the Liberals in office was a standing menace to the prosperity of the Empire. One's hopes in consequence centred round the chances of their early downfall. But till last December there was nothing to suggest an early demise, for the bye-elections had not

given much encouragement to hope for a speedy reversal of the 1906 election results. Since the New Year has dawned, however, a startling change has come over the scenes. Various bye-elections have been fought in different parts of England and have resulted in the loss to the Liberals of several seats that a few months ago would have been thought absolutely safe. Majorities of over one thousand have been wiped away, and the climax came a few days ago when the first Liberal seat in London to be contested since the General Election was wrested from the Government with truly startling force. A Liberal majority of over 2,300 was turned into a minority of almost 2,500. It may be said at once that several of the principal issues involved at this election were solely concerned with domestic legislation; but at all the recent elections where the Unionist success has been most pronounced the Unionist candidate has been a whole-hearted tariff reformer. This goes a long way to show that the British people are fast waking up to the desirability of some change in their fiscal system both in relation to foreign States and to their own Colonies. If the present rate of conversion continues, we have no doubt that in a few years more the death knell of official Cobdenism will be sounded, and a fiscal policy more in keeping with that of other nations will be evolved. Much as other nations, who have benefited by our free trade policy, may regret the threatened change, it is puerile to suppose that they will seriously object to our arming ourselves with a weapon which they have themselves held for so long and with such profit. Yet it is actually suggested by some waverers in this country that because we have left the door open to the foreigner for so long, any attempts to shut it will meet with terrible reprisals. Fortunately the average Britisher is not made of such timorous stuff, and will view with equanimity any attempts to interfere with his rights. And we fancy that our foreign trade rivals on their part will know better than to quarrel with the inevitable.

The Value of Decimal Figures.

On another page we publish a pertinent plea by an American chemist of some distinction for the abolition of the custom of recording sugar analyses to two or more places of decimals. He questions the practical utility of such a proceeding, inasmuch as in actual practice so many other factors may enter in and more than counteract the niceties of decimal distinctions. He quotes no less an authority than Dr. Hans Landolt in support of his contention. This German expert evidently considered that in Brix readings the nearest tenth was accurate enough. As regards purity coefficients, Mr. Norris gives some examples of the difficulty of obtaining reliable results to the second decimal place for the purity of a solution by using all the precautions possible in the observations, and he consequently contends that "it is all the more unreasonable to give the results in four

figures for purities calculated from observations made in factory laboratories." For ourselves we must say that, viewing the matter from a commonsense point of view and not through the spectacles of a mathematician, it has always been a marvel to us how technicists could find so much time to waste on calculating analytical results to four or more decimal places when for all practical purposes and having regard to the uncertain influence of other factors entering into the case, one or at the most two decimal places would prove ample enough. It may conceivably prove satisfactory to a manufacturer, especially a Frenchman, that he has produced sugars with a purity exceeding that of his neighbouring rival by say ·005 but what practical effect it will have on his output and his profits it is hard to say. Certainly one cannot imagine the consumer expressing his preference for a certain brand of sugar because he has learnt that its purity is *fractionally* superior to that of another.

At the same time, we realize that a custom of so long standing as this system of analysis must certainly have had some grounds to justify its inception; and we should be glad to hear the other side of the case if possible. Perhaps some of our expert readers who have had years of practice in technical analysis will give us the benefit of their experience and either confirm Mr. Norris' objections or else submit some cogent reasons for concluding that he has failed to grasp the real nature and value of what is admittedly a rather complicated system.

The Central Eureka, Porto Rico.

Those who believe firmly in the superiority of modern plant for sugar factories as compared with old apparatus will receive something of a shock if the news to hand from Porto Rico about the new Central Eureka is all that is claimed for it. An esteemed correspondent writes to us as follows: "It may interest you to know that this Central has been built by a syndicate of local planters with my assistance, and is a great combination of old and new machinery. When we started work last May it was intended that it should be entirely of old machinery picked up at the various factories all over the island, but as we began to feel our way a little clearer we decided to buy a new nine-roller mill so that we would be able at least to get all the possible juice out of the cane. Some years ago a salesman of the Stirling Boiler Co. sold a large number of Stirling boilers in the island to which was attached a patent furnace working with forced draught but without any combustion chamber, and the results were so disastrous that the boiler got a most unenviable reputation, and in some instances was abandoned and multitubular boilers substituted. Being convinced from previous experience that it was the furnace and not the boiler that was at fault, I had no hesitation in availing myself of an opportunity to buy a couple of 500 H.P. boilers which had been

so abandoned and which were as good as new, and the result has quite justified my opinion as we are now grinding regularly and with juice of only 7 degrees Beaume, we are running without other fuel than the bagasse. We bought an old English triple effect and vacuum pan, old English Weston centrifugals, new donkey pumps and new steam piping, and now have a factory that compares favourably with any of the most modern ones in the island. It was the general opinion that we would have lots of trouble when we started with this combination of old machinery, but the result is quite the contrary, as there has never been a factory in Porto Rico that has started so well, almost without interruption one might say, and we have not lost one stick of cane nor once had to stop the cane cutting, and are grinding from 350 to 400 tons of cane per day." This is certainly a big tribute to the excellent quality and construction of the old machinery. The English portion of it was evidently derived from some of the numerous plants which were sent out to Porto Rico from this country in the old days when there was no prohibitive tariff levied against all other than American machinery. We regret that our correspondent does not state from where they ordered their new nine-roller mill, but we fear that considerations of cost (owing to *ad valorem* duties) obliged the order to be sent to the United States.

Technical Abstracts.

We have pleasure in drawing the attention of our readers to a new feature which we are introducing with this number of the *International Sugar Journal*. Realizing the multiplicity of technical publications existing at the present day, and the impossibility of any one person scanning them all save at considerable expense, we have arranged to give month by month abstracts from such papers, both British and foreign, of all the chief subjects appearing in their pages which will be likely to prove of interest to our readers. We shall endeavour to make the list as complete as possible, and we trust that the trouble we are taking will meet with our readers' appreciation. We would remark here that we are always ready to receive suggestions as to improvements, and if our readers will only take the opportunity to let us know their wants, we will do the best we can. In selecting these abstracts, for instance, we are presuming that they are such as will prove the most suitable to the majority, but we do not desire to draw any hard and fast line, and will modify them if they appear unsuitable.

The Cuban Outlook.

We publish in this month's issue a letter from a Cuban planter who makes a strong complaint on the way matters are being managed in Cuba. He asserts that the Government have failed to restore confidence and that in consequence the much needed capital required to help the planters to tide over affairs is not forthcoming. $5,000,000

was recently loaned by the Cuban Treasury free of all interest for six months to the Cuban bankers with the declared object of helping cane planters and farmers, but complaints are not wanting that none of this money has got into the hands of those for whom it was destined. When added to this they have had the additional drawback of an unusually dry season which has stunted the growth of the canes, and repeated outbreaks of incendiarism have occurred, it is not to be wondered at that the prospects of the coming crop are decidedly poor. Our correspondent goes so far as to put the minimum shortage at 40% or 50% of last year's yield. Willett & Gray and Guma do not as yet give such pessimistic figures, but they admit that there will be a deficit, and if it assumes the large proportions shadowed by our informant it will be a rather serious matter for the sugar market, which will have to draw more largely on beet supplies. In any case it is evident that we must be prepared for a rise in the price of sugar between now and the autumn. At the time of writing beet is quoted at 11s. as compared with 9s. 3d. a year ago.

The Sugar Consumption Tax in Japan.

The *Board of Trade Journal* reports that the consumption tax on sugar (which is levied on both home-produced and imported sugar) has been increased with effect from 22nd February last, and the former and new rates of this tax are shown in the following statement:—

Kinds of Sugar.	Rate of Consumption Tax. Former. Kin.	Yen.	Present. Kin.	Yen.
Sugar, Class I. (below No. 8, Dutch standard) and molasses	100	2·00	100	3·00
Sugar, Class II. (from No. 8 to No. 15, exclusive, Dutch standard)	,,	4·40	,,	5·50
Sugar, Class III. (from No. 15 to No. 20, inclusive, Dutch standard)	,,	6·50	,,	8·50
Sugar, Class IV. (above No. 20, Dutch standard) and candy	,,	7·50	,,	10·00

100 kin. = 132·5 lbs. avoirdupois. 1 yen = 4s. 1d.

Sugar Supplies.

How advisable it is for this country to have ample sources of supply for its sugar is shown by the *Board of Trade* figures for the imports of sugar into the United Kingdom during the first two months of this year, as compared with the same period in 1907. We find that while Java sent us only 32 cwts. in 1907, she has sent us this year over 33,000 cwts. Peru's supply has increased from 74,000 to 188,000 cwts. On the other hand Germany's contribution have dropped from 1,611,822 to 1,255,000 cwts. and Brazil's large supply of 177,945 cwts. last year is represented this year by a beggarly 1,600 cwts. All this goes to show that it is in the interests of the sugar consumer to encourage as wide an extension of the sugar industry as possible, but such extension was utterly impracticable as long as the bounty system held sway.

THE NEW SUGAR CONVENTION.

V.

A Retrospect and a Forecast.

Now that international questions are probably settled for another five years it may be useful to take a brief survey of the situation of the world's sugar industry. It is to be hoped that—*pace* Mr. Thomas Gibson Bowles—we may now be free to look at real influences, uninterrupted by the silly outcries of political partisans, who take a savage delight in inventing grievances which have no foundation and in imputing the effects of bad crops or increased consumption to other causes, the creations of their own diseased imagination. We know that the low prices of 1901-2 spelt ruin not only to natural producers but even to many of those who were receiving handsome bounties. Germany and Austria may have been disposed to continue their excessive production in order the more effectually to cripple all outside competition, but as a body the European beetroot sugar producers were bound, in self-preservation, to reduce sowings in 1902, in order to break the back of the enormous stocks which weighed upon the markets of the world. They did so in a moderate way, and prices recovered from 6s. to 8s. 6d. This was declared, by the political touts, to be the effect of an international Convention which did not come into operation till eighteen months afterwards. The sowings of 1903, the sugar from which would come on the market after bounties were abolished, were actually an increase on those of 1902. The political touts kept silence; but they were in full cry again when, in 1904, there was a disastrous drought in the beetroot districts, which deprived the world suddenly of 1,200,000 tons of sugar. Here, at last, they cried, was the pernicious effect of the abolition of bounties in full evidence. Dear sugar was one of the cries which poisoned the minds of the poor bewildered British electors. A sudden deficiency of over a million tons of sugar was enough to disturb sugar markets under any circumstances, and prices rose in spite of heavy stocks. High prices soon had their desired effect. Big sowings in 1905, and an exceptionally good season, brought the market down to the old figure of 8s. 6d. Again the political touts kept silence; but when the General Election came they again began to scream "dear sugar!" The British elector did not know that the market had gone down again.

We hope we may have a respite from this kind of political economy and be able to take breath and collect our thoughts for more useful speculations as to the future. It is true that the door has been thrown open once more to bounty-fed sugar. Russian sugar is to be protected on British markets, and we shall perhaps have another bad quarter of an hour from our so-called political economists when

September comes. Russia has been making too much sugar and has a large unsold stock waiting for us. If it comes with a rush we shall be told that this is the sugar that was shut out by the penal clause. It was not shut out because it did not exist till a year ago; but that is one of those plain facts which are habitually disregarded by political partisans.

This reappearance of bounty-fed sugar will be interesting to watch. It comes at a most opportune moment, because prices are going up owing to short crops in Cuba, Java, and other places. Opportune we mean from the consumer's point of view. For the British refiner the advent of large quantities of white Russian sugar would, under the circumstances, be most inconvenient. He will be paying, probably, high prices for his raw material, and will find the competition of a flood of inferior white sugar very injurious to his "margin." But the temporary glut of white sugar in the market is a small matter compared with the consideration of the ultimate result of the Russian competition. As we said last month, it is not likely that the Russian producers will continue to overstock themselves with unsaleable surplus production. This forecast seems to be confirmed if we are to credit a report that the manufacturers are appealing to their Government "to apportion the quota of sugar to be exported among the different factories according to the actual output of each factory," and "to reduce the authorised production of home sugar for next season, so that it shall not exceed 50,000,000 poods, on the ground that the surplus stock of the present season is excessive." If in spite of all this the manufacturers persist in maintaining the large surplus we should advise them to make it in the form of raw sugar, a much more saleable article.

Russia is the only disturbance left in the form of bounty-fed competition, unless, perchance, Italy should take the advantage of the reopened door and try her hand at swamping the world. It would be an interesting experiment, with perhaps Spain to help her.

We turn to a more serious interference with the natural course of sugar production. Our international friends at Brussels would have liked to have treated it as coming within the definitions under Article I. of the Convention, but that could not be allowed. The United States give preferences in their sugar tariff. Their own cane and beet sugar is admitted duty free; so is sugar from the Sandwich Islands and Porto Rico. All that sugar enjoys, therefore, in the markets of the United States, an increased price of nearly 8s. per cwt.—a pretty good extra profit. The Philippine Islands have a preference of 25 per cent., and Cuba gets 20 per cent. Even these are very nice little bonuses. The result is that all these sources of sugar production, with the exception of the Philippines, have been artificially stimulated to increase their production. Cuba would, no doubt, in any case have increased her production

to the level reached before the war, but it is certain that Louisiana and the United States beetroot industry are entirely supported by the big bonus. Porto Rico and the Sandwich Islands have great natural advantages, but there can be little doubt that their largely increased production has been to a great extent the result of their sugar being admitted into United States markets free of duty. All this causes a considerable disturbance to the natural course of sugar production and distribution. The consumption of the United States is now almost entirely supplied from these favoured sources of production. The result is curious. All these countries produce their sugar during some of the months from October to May, and therefore a great part of the 2,500,000 tons which they produce is forced into the United States markets in the winter and early part of the following year. The effect has recently been remarkable. We used to speak of the world's price of sugar as being fairly uniform; but now, owing to continuous forced sales on an unwilling market, the price of sugar in the United States, independent of duty, is always very much lower during the early months than the price in Europe or elsewhere. It is not quite correct to say that this means that the Cubans have given away their preference, which has gone into the pockets of the American refiner. They still have their preference, but they have forced prices down by trying to get rid of a big crop too quickly. The only way that the United States refiner benefits is by buying sugar so much below the European level that European refined sugar cannot compete. He is therefore able to keep his margin between raw and refined at its normal amount. To say that the Cuban preference goes into his pocket is clearly erroneous, because if it did his margin would be raised by that amount. As a matter of fact the margin remains practically the same, and is even reduced if the change in values is too rapid. The injury caused to other western sugar producers by this artificial disturbance of the equilibrium is very serious, and is twofold in its character. The stimulus to production in the favoured countries not only inflicts the same injury on unprotected producers as direct bounty-fed competition would, but also tends gradually to squeeze them out of their accustomed markets in the United States. Then comes the artificial fall in value below European level, which forces all the unprotected producers to seek other markets. Our unfortunate West Indian colonies have practically lost the United States market and do not appear to get much comfort next door, in Canada, where they foolishly allow the refiner to gobble up all their little preference.

The most interesting point in the whole story is that when the favoured countries produce enough for the United States' consumption the entire arrangement will fall to pieces like a pack of cards. The full sugar duty will cease to exist, Cuba will still have to pay 75 per cent. of it, and the other countries will have that amount

of advantage over her, but they will hardly be able to pocket that amount on all occasions. No doubt this state of things will be followed—or perhaps anticipated—by some radical change in the United States' sugar tariff. Whatever that change may be there can be little doubt that Cuba will gain and the other industries lose by it. Cuba will become more and more the great dominant sugar producing country of the world. Bolstered up industries will fall rapidly into the back ground. The European sugar producers will have to look to their home markets for salvation, and Russia will, five years hence, be compelled to come into line with her European neighbours.

A great change has taken place of late years in the distribution of the world's sugar production. At one time we used in this country principally the sugar of our own colonies. Java sugar went to Holland and was then redistributed. Manilla sugar subsequently came here in large quantities, and so did similar low class sugars from Brazil and British India. Even China sent us a good deal on special occasions. As time went on Java sugar became one of the main supplies for British refiners, and we got a similar high class sugar from Cuba, which was called Havana sugar. Those were the palmy days for the great merchants and brokers who made fortunes by the shipment and turnover of what were considered at that time big cargoes of raw sugar from these main sources of supply. It was solely on "raw material" in those days that the British sugar duties were levied, but we did not hear from the economists of that era that such a duty was a great economic heresy. Then came European beetroot and knocked all the old associations on the head. Foreign refined, with a big bounty, took the place of raw sugar cargoes from the East and West Indies. Those big argosies are bigger now and far more numerous, but they sail no longer to Falmouth for orders, to the Thames, the Mersey or the Clyde. Foreign refined with the big bounty drove them away, and no Government, Whig or Tory, would come to the rescue and restore free trade because, forsooth, free trade was contrary to the fiscal policy of the country. Therefore those cargoes now sail to New York, Boston and Philadelphia, where a tiny little protection of 7d. per cwt. enables the American sugar refiner to earn a living.

But the most recent revolution in the distribution of sugar is the new outlet to the East. Java sends less and less sugar every year to the West. Mauritius sugar in western markets has almost become a thing of the past. Even the ubiquitous German and Austrian granulated flows towards the East by fits and starts. No one knows how far this new development will spread. India is said to produce from two to three million tons of sugar. If that production were carried on under modern conditions there could be no need for India to send to Germany, or even to Mauritius and Java, for her sugar.

There seems to be some want of enterprise in that country, where there ought to be a fine field for our great sugar machinery makers in the near future. The world's consumption is expanding with great rapidity and we shall want some more raw sugar cargoes presently, say at the end of the next five years.

At the expiration of the five years one thing must inevitably be done. We must not allow the ridiculous concession, that Great Britain would give no preference to her Colonies, to remain any longer among the Articles of the Convention. It is almost incredible that such a Concession should ever have been made. It was entirely uncalled for and gratuitous. This country was master of the situation, and had a perfect right to do what all the Contracting States were authorised to do to the extent of 2s. 6d. per cwt. The Concession was made to please the so-called free trade members of the Government, who also manifested their curiously crooked ideas of free trade by preferring the violent and unjustifiable penalty of "prohibition" to the purely free trade and strictly scientific penalty of a countervailing duty. These are some of the comical results of the erroneous impression—universal among those who now proudly call themselves "the bulwarks of free trade"—that so long as we stick to the legend "duty for revenue purposes only" we have free trade; and that the slightest departure from it is wicked "Protection." They entirely repudiate the assertion of a very distinguished free trader—who preferred reason to dogma—that "a duty to countervail a bounty is not only consistent with free trade but positively conceived in the interests of free trade." As one of their body has admitted, they are still suffering from "invincible ignorance." The country begins to have a glimmering idea that what our industries want is *freedom of competition*, and that that is sometimes inconsistent with free imports. When the so-called free traders have learned this rudimentary fact they may perhaps hold their peace even if they refuse to be converted.

The Swedish Riksdag passed on March 7th the Bill relating to the Act Supplementary to the Brussels Sugar Convention of 1902.

According to information given in the House of Commons, the total amount of sugar used for brewing in the United Kingdom for the year ended September, 1907, including the equivalents of syrups, glucose and saccharine, was 2,859,487 cwts.

The Chancellor of the Exchequer was recently asked whether he was prepared to assist persons proposing to put up beet sugar factories in Suffolk and Lincolnshire by giving them the assurance that an excise duty would not be imposed on the sugar they might produce, at any rate for a term of years. His answer as might have been expected was a refusal.

OBJECTIONS TO THE USE OF THE SECOND DECIMAL PLACE IN EXPRESSING THE RESULTS OF THE ANALYSIS OF SUGAR FACTORY PRODUCTS.

By R. S. Norris.

It is quite a general practice in reporting the results of the analysis of sugars and sugar solutions to carry the figures out to the second decimal place. The polarization of a sample of raw sugar, for instance, is given as 96·42. It is worth while to consider whether this practice is justifiable—whether results expressed to this degree of refinement are nearer the truth than if given to the first place of decimals only.

The subject can be discussed more clearly by considering first the simple deterioration of the Brix, or the polarization, of a given sugar solution, or the polarization of a homogeneous solid substance containing sugar, without regard to its origin or its relation to any other product; and then to consider the analysis of laboratory samples of various sugar factory products, taking into account their relation to each other and to the entire amount of the products which they are supposed to represent.

Brix Determinations.

The Brix of sugar solutions is determined with three different kinds of physical apparatus—the pyknometer, the Westphal balance, and the Brix hydrometer. The first is generally used only in scientific investigations. It is possible with careful work to determine the Brix of a solution accurately to 0·01 with a delicate pyknometer. Westphal balances are usually not sensitive enough to determine the Brix within less than 0·1 with accuracy. Hydrometers are used more often than the other two kinds of apparatus. They are almost universally used in practical work. To anyone who has had much experience in attempting to make an accurate determination of the Brix of a solution with a hydrometer, it is well known that it is difficult to get several readings on the same solution to agree within 0·1. The tenth of a degree Brix is such a small amount in terms of specific gravity that very slight differences in the conditions between two or more readings affect the readings more than 0·1. The value of one-tenth of a degree Brix in specific gravity varies from 0·00038 for dilute solutions to 0·00075 for concentrated solutions. It is hardly possible then, even with the greatest care, to determine the Brix with a hydrometer to within less than 0·1. Furthermore Brix hydrometers, even of the so-called standard quality, are rarely accurate within 0·1, and frequently give readings of more than 0·5 too high or too low. The writer has recently seen tested a lot of *standard* hydrometers of only ten degrees range which read as much

as 0·8 of a degree too high. Hydrometers are seldom tested by those who use them in sugar laboratories, but are accepted as correct.

When the solution whose Brix is being taken is not at the standard temperature it is necessary to make a correction for temperature in the reading to get the true Brix. These corrections are usually given in tables to the second decimal place, and it is the practice to add or subtract the correction just as it is given in the table. This practice is responsible in a great many cases for the readings being recorded in the second decimal place, although there can be no justification for doing so. If a solution gives a reading of 20·4 with the hydrometer at 24° C. it is not correct to say that the corrected Brix is 20·84, because if the density were determined with a pyknometer it might be found that the actual Brix at 24° C. was 20·43, which would make the corrected Brix 20·87. And furthermore, if the solution were not a pure sugar solution the temperature correction as given in the table would not be correct to the second decimal place for this particular solution. Professor H. Landolt,* a leading authority on sugar analysis, has the following to say in regard to the use of the table for temperature corrections: "The number of degrees read off on the spindle holds for the normal temperature of 17·5° C. If the liquid does not happen to have the normal temperature, the degrees read off must be corrected by aid of the following table, after the true temperature is found by means of a thermometer attached to the body of the spindle. After the correction, the Brix degrees are to be rounded off in tenths by considering five or more hundredths as a full tenth, and small fractions neglected."

Polarizations.

The polarization of saccharine liquids or solids, except possibly in a few unusual cases, cannot be determined with certainty to a hundredth of one per cent. In dilute solutions correct polarizations within less than a tenth of one per cent. may be obtained by taking 100 cubic centimetres of the solution, and finding the polarization corresponding to the reading from Schmitz's table. By this method the polarization of a solution can be found to about one-fortieth of one per cent. It is possible also by careful work, and with the use of correctly graduated measuring apparatus, to arrive at the correct polarization within less than a tenth of one per cent., by taking a number of readings and calculating the average, with the limit of error, to the second decimal place. (It is not strictly correct to state the average without also giving the limit of error, as this would assume that the number as given is accurate within one-hundredth of one per cent.) But the careful work and the correctly graduated apparatus upon which the accuracy of such refined results depend are not ordinarily to be found in sugar laboratories. And it is not meant

* The Optical Rotating Power of Organic Substances and its Practical Applications. By Doctor Hans Landolt, translated by Dr. John H. Long, p. 474.

by this that the work in sugar laboratories is less carefully done than in other chemical laboratories. Chemical measuring apparatus of all kinds is quite commonly assumed to be correct, when it would be found frequently to be incorrect if tested. And the analytical work in sugar laboratories is probably as carefully carried out in general as the methods of sampling would warrant or the use to which the results are to be put would require. But on the other hand when it comes to stating the results it is generally assumed necessary to go to a limit of refinement that the methods of analysis do not at all warrant.

Purity Coefficients.

Since the polarization of a solution cannot be determined to a hundredth of one per cent., it is not possible to calculate the apparent purity coefficient accurately to the second decimal place. But even if it were possible to find the correct polarization of a solution to a hundredth of one per cent., the apparent purity could not be determined with certainty to a hundredth of a degree, except in cases of very heavy solutions—over 90 Brix. The variation in the calculated purities of solutions is so large for small differences in the polarization or the Brix that differences of one-hundredth of one per cent. in purities have no meaning. In two solutions, for instance (*a*) Brix 35·22, Pol. 31·64, and (*b*) Brix 35·22, Pol. 31·65, the calculated purities of which are 89·83 and 89·86 respectively, we could not say with certainty that if it were possible to determine the polarization to one-thousandth of one per cent. the purities might not be 89·82 and 89·87. In more dilute solutions than this the variations in the calculated purities for small differences in Brix or polarization are much greater than this. As an example, two solutions (*a*) Brix 3·42, Pol. 3·01, and (*b*) Brix 3·42, Pol. 3·02 would have calculated purities of 88·01 and 88·30 respectively, so that it means just as much to express the purities as 88·0 and 88·3 as to carry them out further.

Since it is not possible therefore to obtain reliable results to the second decimal place for the purity of a solution by using all the precautions possible in the observations, it is all the more unreasonable to give the results in four figures for purities calculated from observations made in factory laboratories.

Landolt* advises that when calculating purities in practical sugar analysis, "in stating the final results fractions less than full tenths are omitted."

Factory Control Work.

The accuracy of all the results obtained in the laboratory of a sugar factory depends in the first place upon the samples taken—whether they are strictly representative. It is probably no exaggeration to say that samples taken while a factory is in operation are never absolutely

* Loc. cit. p. 475.

correct representatives of the products which they stand for. Samples taken at intervals are, of course, only roughly representative. The so-called continuous samples are more nearly so, but these vary considerably from accuracy depending on the steadiness with which the cane mill is running, freedom from stoppages of the samplers themselves, and from fermentation and evaporation of the samples before analysis. Also when a given product is analysed several times a day, the different samples do not represent the same weight of the product; and that of the least weight then has a disproportionately large influence on the average. For this reason the analysis of the samples of juices taken at different stages of the process during a particular interval of time—for a day for instance—are only roughly comparable with one another, and there is no object therefore in attempting to determine their polarization or their purity beyond the first decimal place. The results of the determinations probably seldom express the correct per cent. of sugar or the purity of the whole of the product within a tenth of one per cent.

Averages.

In calculating weekly and monthly averages, even when daily analyses are expressed only in tenths of one per cent., the results are frequently carried out one decimal place further than the separate items. In scientific investigations where each result is determined with great accuracy there is some justification in carrying the average result out one decimal place beyond that of the separate results, stating at the same time the limit of error. But even in that most refined kind of chemical analysis, atomic weight determinations, average results are usually expressed only in the same number of decimal places as the separate determinations. For instance, Baxter* made thirty-one determinations of the atomic weight of bromine with results varying from 79·946 to 79·959, the average of which he gives as 79·953. If there were good reasons for carrying the mean result of averages out to one decimal place further than the separate results one would expect to find the practice followed in atomic weight determinations. And if it is not done in this kind of chemical work there can be no excuse for doing so with the necessary crude results from work carried on in factory laboratories. This is especially true of the determinations of sucrose in cane, which on account of the indirect method of determination cannot be depended upon to be correct within much less than half a per cent. In factory reports for periods of a week or more the per cent. of sucrose in the cane is usually given to a hundredth of one per cent., whereas the results as given are probably not correct within a tenth of one per cent. The difference in the weight of sugar in a thousand tons of cane containing 14·25 % sucrose and the same amount containing 14·24 % sucrose is considerable; and it would seem desirable to take account of it in reports.

* *Jour. Am. Chem. Soc.*, 28, 1322.

But as it is impossible to determine accurately in the ordinary operation of a factory whether the thousand tons of cane crushed contained 14·2 % or 14·3 % sucrose, it is but begging the question to attempt to arrive at a more accurate result by carrying the average of the daily results out to a hundredth of one per cent.

Advantage of Expressing Results Only to the First Place of Decimals.

1. Results expressed only to a tenth of one per cent. are as accurate in general as those carried to a hundredth of one per cent., and are nearer the truth as actually determined by analysis.

2. All calculations in which the results are used are simplified, as is also the printing of tables by the use of the simpler form of expression. The calculation of purity coefficients can be entirely dispensed with by the use of simple tables, when the Brix and polarization are given in tenths of one per cent.

AN IMPROVED QUADRUPLE EFFECT EVAPORATOR.

Messrs. James Buchanan & Son, Caledonia Engine Works, Liverpool, N., have just completed the delivery, erection and setting to work of three sets of quadruple-effect evaporators, each set of which was designed to treat 90,000 gallons of liquor per day of 24 hours, and to evaporate therefrom 320 tons of water. Special arrangements were made to prevent as far as possible the formation of scale, as the liquor being treated contained a large amount of scale-forming ingredients.

Each set of pans consists of three evaporating vessels and a concentrating pan all 8 ft. 6 in. diameter, the steam drums being constructed of mild steel plates with steel tube plates fitted with wrought-iron tubes. At the bottom of each drum there is a cast-iron distance piece on to which all the connections are made, so as to enable the pan bottom to be lowered without breaking the connections. Air mains of large diameter are provided between all the pans, the third and fourth pans being joined together into one air main, which is connected up to a counter-current condenser of special construction, fitted with spray baffle plates, the vapour inlet being 30 in. diameter.

Each set of pans is worked by a vacuum pumping engine of the double flywheel type, having steam cylinder 16 in. diameter × 18 in. stroke driving a double-acting vacuum pump of the displacement type 18 in. diameter × 18 in. stroke, one circulating water pump 11 in. diameter × 18 in. stroke, and two condensed water pumps each 4 in. diameter × 18 in. stroke, all running at a speed of 60 revolutions per minute.

The weak liquor is fed into the first pan from an overhead tank and the strong or concentrated liquor is pumped from the last pan by a

specially-designed extracting pump, so arranged that the valves are readily accessible for renewals or attention. This pump is driven by means of a connecting rod from a crank disc, having a variable stroke of 9 in. to 12 in.

The pans are fitted with special testing arrangements by which the strength of the liquor passing from one pan to the other can be readily ascertained. The liquor entering the pan is by means of a novel device spread out in the form of a spray, which allows the vapour to readily leave the liquor, and thus ensures quick evaporation.

The first set of pans was delivered and worked continuously for five months before the second set was started. They were then stopped, and we are informed that practically no scale at all had formed on the tubes or tube plates. The second set was then used continuously for two months, and the third set started with the same result, practically no scale in the second set, this avoidance of scale being entirely due to the very rapid circulation and special arrangements made. The results have quite exceeded all expectations.

In conclusion, it may be stated that from the time of first turning on of the steam to the engine the plants never stopped working night or day until the succeeding sets were started, thus showing that great care and experience must have been exercised by the makers in the design and manufacture of the plants, which are a speciality of theirs. The improvements made in the above-described plants could be embodied in evaporators for all kinds of liquors, such as sugar, brine, &c., &c.

THE ESSENTIAL MINERAL CONSTITUENTS OF THE SUGAR CANE.

By T. Murakami, B.Sc.,
(Government Sugar Experiment Station, Formosa).

A careful study of the quantities of mineral matter removed from the soil by sugar cane cultivation and of the proportions in which these should be applied in the form of manure is of no small importance both to the practical farmer and to the scientist. A subject of so much interest to the sugar industry has naturally received a good deal of attention from agricultural chemists, yet no definite conclusions seem to have been arrived at. During the last thirty years wonderful progress has been made in the science of agriculture, yet there are at present only two methods of determining what are the essential mineral constituents of the sugar cane. The first is based upon the composition of cane ash as determined by analysis, but is of an arbitrary character, since we are quite unable to say that the mineral constituents of the cane are as simple as those found in the ash.

The other method is based on the amount of mineral matters contained either in the soil or added in the form of manure, and which are absorbed by the sugar cane crop. This is undoubtedly more reliable and accurate than the first method, but it is difficult to control the conditions prevailing during vegetation. In order to arrive at reliable results, a certain excess of mineral matter (as manure) is added to the soil till the canes mature; samples of canes being analysed at different periods. The following are some analyses so obtained:—

IN 100 PARTS OF ASH.

Composition. Different Stages of Growth.	CaO.	MgO.	$Fe_2O_3 + Al_2O_3$	SO_3	P_2O_5	K_2O	Na_2O	Total Ash on Cane.	Total Nitrogen on Cane.
	%	%	%	%	%	%	%	%	%
Over ripe ..	7·450	7·104	6·877	19·1	3·033	7·470	16·849	·349	·048
Just ripe ..	6·304	6·602	6·304	11·279	3·394	8·900	17·200	·303	·053
Under ripe ..	4·585	4·621	6·877	15·195	3·755	9·650	21·500	·275	·078

From these results the following conclusions can be drawn:—

(1.) The nitrogen content decreases as the cane grows.

(2.) The total ash of cane increases as the cane grows.

(3.) The contents of nitrogen and ash counterbalance each other in the course of the cane's development.

(4.) Phosphoric acid and potash appear to decrease per 100 parts of ash, but are always constant per 100 parts of cane.

(5.) The ratio of soda to potash is constant.

(6.) The only ingredients that increase are oxide of iron and alumina, sulphuric acid, and perhaps silica.

(7.) A certain ratio exists between lime and magnesia, and this ratio varies slightly as the cane matures.

(8.) The ratio between phosphoric acid and potash is 1 : 26 and does not change during the cane's growth.

Taking these data as a basis for calculation, the absorbing power of the essential mineral ingredients of Formosan sugar cane is as follows:—

Different Stages of Growth. Essential Ingredients.	Over Ripe. Per cent.	Just Ripe. Per cent.	Under Ripe. Per cent.
Nitrogen (N)	57 ..	59·6 ..	68·1
Phosphoric Acid (P_2O_5) ..	11·8 ..	11·1 ..	8·7
Potash (K_2O)	31·2 ..	29·3 ..	23·2

The Relation between Lime and Magnesia.

In order to ascertain whether different ingredients added as a manure alter the relation existing between magnesia and lime absorbed by the sugar cane, from a manured plot, we carried out some experiments with the following results:—

Plots.	No. Manure Plots.	Nitrogen Plot (A).	Nitrogen Plot (B).	Complete Plot.	No. of Potash Plot.	No. Phosphoric Acid Plot.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
CaO.. ..	10·572	9·169	9·247	8·257	5·970	8·497
MgO.	9·832	8·829	8·238	8·581	8·597	8·004
Ratio.. ..	1·07	1·04	1·12	·96	·69	1·06

It will be seen from these data that in spite of the amount and the nature of the ingredients present in the soil, the sugar cane always absorbs lime and magnesia in the same relative proportion, which ranges from 0·96 to 1·07.

These data were obtained in connection with experiments on the *Rose Bamboo*, but as it was of interest to compare the ratio of lime and magnesia in various other sugar canes, we obtained the following results:—

Comparison of Ratios of Lime and Magnesia in various Canes.

Species.	Rocha (waxy cane) the Formosan Species.		Striped Singapore.		Rose Bamboo.		Mauritius Bingham.		Java.	Scarlet.
	Leaf.	Stalk.	Leaf.	Stalk.	Leaf.	Stalk.	Leaf.	Stalk.	Leaf.	Stalk.
	%	%	%	%	%	%	%	%	%	%
CaO. ..	8·157	7·826	6·520	12·784	4·818	3·521	5·642	16·046	4·065	11·530
MgO. ..	8·135	12·84	6·540	13·653	5·246	3·630	7·334	16·577	4·607	14·330
Ratio ..	1·00	·61	·99	·93	·91	·97	·77	·97	·88	·80

It will be seen from these analytical data that the samples of various canes taken before their full development likewise show a ratio of lime and magnesia approximately the same, and furthermore that this ratio is generally constant in leaves and stalks.

On our sugar experiment station there are two parts of the same field which appeared to differ very considerably in fertility, and it seemed desirable to investigate the cause. On carefully obtaining samples of canes and soils from each of these spots, the following analytical data were obtained.

Comparison of Canes cultivated in different Spots in the same Field.

Spot Yielding.	Physical Examination.				
	Length of Cane.	Length of Stalk.	Diameter.	Weight of Stalk.	Weight of Leaf.
Maximum crop ..	3·11 m.	1·5 m.	3 c.m.	780·5 gm.	500 gm.
Minimum crop ..	2·3 m.	·5 m.	2·7 c.m.	192 gm.	36·2 gm.

Ash.	Chemical Composition (in 100 parts of Cane).				In 100 parts of Ash.			
					Lime.		Magnesia.	
	Moisture	Sucrose.	Glucose.	Fibre and Non-Sucrose.	Stalk.	Leaf.	Stalk.	Leaf.
%	%	%	%	%	%	%	%	%
·177	81·233	5	4·264	9·326	3·091	1·593	3·704	1·529
·428	86·655	2	4·264	6·652	8·451	4·342	13·966	3·1267

Comparison on Composition of Soils.

Soils Yielding.	Igni-tion Loss.	Humus.	N.	Insoluble matter in HCl.	Mois-ture.	SiO_2.	Al_2O_3.	CaO.
Maximum crop..	1·240	5·600	·062	95·760	·920	·045	·891	·075
Minimum crop..	3·300	1·600	·104	94·925	·63	·085	·831	·225

MgO.	MnO.	K_2O.	Na_2O.	P_2O_5.	Fe_2O_3.	SO_3.	CO_2.	Cl.	Absorbing Power.	
									N.	P_2O_5.
·072	·075	·209	·074	·284	1·000	·255	·026	·002	72·8	258·4
·081	·225	·077	·491	·093	·400	·264	·026	·002	18·4	757·4

From the foregoing results it will be seen that the maximum crop and the maximum sugar content of canes are obtained from a rich soil in which such essential ingredients are distributed in an assimilable condition, for the immediate needs of the canes. Therefore in applying fertilizers, lime should be added in conjunction with the supply of the other three ingredients (N, P_2O_5 and K_2O) in order to maintain the proper rates between lime and magnesia.

There is no doubt that a thorough investigation of this question would lead to interesting and important results. The nature and amount of the work involved is beyond the scope of any single investigator; but the writer offers these preliminary notes in the hope that others will follow this line of research.

HAWAIIAN ISLANDS.

Modern Sugar Factory Practice.

The Hawaiian Sugar Planters' Association recently appointed one of their number to visit the mills on the various plantations in the Islands and furnish a report on the development of the machinery used in the Hawaiian sugar industry.

This gentleman, Mr. W. J. Dyer, carried out his mission, and his report was presented to the last annual meeting of the Association. We propose to give here a resumé of the chief points dealt with by him.

As regards milling machinery, the nine or twelve-roller mill in conjunction with maceration forms the best system. Many of the factories apply the maceration in front of the first mill, so as to fully obtain the benefit of this method of extraction.

The machinery used for clarification is said to be of practically the same type as that used twenty years ago. The intermittent settling system appears to give the best results. The Deming continuous process had a brief trial, but did not appear to possess any superior advantages. It is, however, claimed that the Deming system has recently been much improved by the installation of closed settling tanks, which also work on the continuous principle, the advantage of the closed tanks being that the high temperature obtained in the heaters can be continued in the settlers and the heat not be reduced until its delivery from the absorber, when it is ready for evaporation.

The question of a suitable apparatus for weighing or measuring juice is still an unsettled one; further, as to whether the juice should be weighed or measured is still another question; in either case the amount of sucrose in the "weighed" or "measured" juice is a matter of calculation depending on the sucrose contents of the liquor. In several of the Hawaiian mills weighing scales have been installed, which require the continuous attention of an attendant and a suitable automatic register for checking the number of tanks weighed. The weight is stamped on a card by the machine, with the assistance of the attendant, in which the total weight of the tank and juice is indicated. In order to correct the possibility of error in this independent weighing, and further, to dispense with the expense of an attendant, several automatic weighing and measuring machines have been placed on the market, some of which have been tested in Hawaiian factories. It cannot be said that any of these have proved entirely successful, for the special reason that in all cases where automatic weighing machines are used one of the principal requirements for reasonably accurate work is a continuous supply of material or liquor to the weighing apparatus, as any change in the rate of weighing calls for a corresponding adjustment of the weighing machine to this condition when the supply is varying.

There are about twenty different types of filter presses in the Hawaiian mills, in all of which different results are obtained. It is generally conceded that the maceration question has a bearing on this case as in that of mill extraction, and the factories that use the largest amount of water for the purpose of lixiviation in the presses show the lowest amount of sucrose loss, though it is quite possible to carry matters thus to an extreme.

The crystallizer question is receiving a considerable amount of attention, particularly by older factories in which the process of manufacturing the low grades of sugar is still carried on with cooler cars and the last grade delivered into a cistern or series of tanks where it is stored till the end of the season, after which it is pumped or otherwise delivered into the mixer and dried. Such a process is no longer practicable, and in consequence many of the older mills are adopting the more rational method of crystallization in motion. The apparatus generally used is, however, of the open type and not jacketed.

There is still quite a difference of opinion among the plantation people as to the value of the use of a drier. Some claim that if sugar is properly dried in the centrifugals there is no reason for deterioration in the long sea voyage from Hawaii to the Atlantic coast; others assert that when making one grade of sugar, of 96 polarization, it is only a question of time when a ferment will make its appearance which will affect the keeping powers of the sugar, and the only safeguard to prevent the deterioration of sugar in shipment is that it be properly dried with some type of drier. In proof of this the case of certain Cuban sugars has been cited, which in from four to six months deteriorated from three to seven points.

CULTIVATION OF THE SUGAR CANE IN PERU.

The Government Sugar Experiment Station, Lima, Peru, which is under the control of Professor F. T. Sedgwick has recently issued a pamphlet describing the work of the Station during the past year and giving a detailed account of the system of sugar cane cultivation practised in Peru as gleaned from a journey of inspection made by Mr. Sedgwick. This latter part of the report is of more than local interest and below will be found a translation of such portions as we believe will prove acceptable to our readers.

CULTIVATION OF THE CANE.

PREPARING THE GROUND.

(*a*) *Sanitation.*

On the majority of estates damp land is met with, but only on a few has a proper system of drainage been established. This drainage is out of view on a few estates, on others it is in the open, and finally

some have simple channels but no general plan of sanitation. On some estates after draining the damp land, which is probably acid, lime is thrown in and the cane is at once sown; on others, it is not so, but maize, rice or something else is planted, and after harvesting it, the cane is planted.

As regards saline lands, on some estates water is passed over them systematically, after having established a system of drainage; on others, it is done superficially; on some, very turbid water is used, the deposits from which neutralize somewhat the effects of the saline spots; on others, only very continuous irrigation is usual, to the detriment of the plant; and on others again, the fields are left alone.

This sanitation is being carried out in a systematic way on some estates, and so year by year a few fanegadas (about 1·6 acres) of ground is gained.

(*b*) *Clearing and Preparing the Land.*

On most estates the axe is used for clearing; we have not yet seen machinery used for felling, &c. There are twin ploughs—steam driven, of Fowler's double engine system with Cuban balance plough, harrow and Cambridge roller. These ploughs are met with on the large estates, but on some small ones yokes are used for ploughing the fields. On one estate we saw a traction engine used. We have seen disc ploughs used with Fowler's engines which give good results on somewhat damp soil.

For pulverizing the soil (clod-breaking) the Croskill Roller is used on most estates. The landowners, for the most part, pass the plough three times over the soil, in opposite directions, to a depth of 35 to 45 centimetres.

(*c*) *Making the Furrows.*

On certain estates in order to form the furrows, they place stakes at the ends of the fields, and trace the outline of the furrow with a native plough, being guided by the stakes laid down, and afterwards they deepen them with a deep plough. On others they put a row of stakes in the field and with a deep plough they mark out the furrow, in such a way that the central part of the yoke knocks down the stakes, and afterwards they deepen the furrow; on others again they mark out with Collin's single-share ploughs, and in order to deepen they pass the deep plough over again. On other estates they mark the first furrow with lime, and open it up with an iron plough which has an apparatus for marking, and which goes on marking out the following furrow, and then the ordinary plough is passed over.

The depth of the furrows varies: thus, on estates having dry soils, it is about 35 to 45 cm., while on those with damp ground the depth is less. The width ranges from 1·10 and 1·20 to 1·30 and 1·50. The Cuban systems of 3 m. 65 and 2·43 (12 and 8 feet) are also being tried.

(*d*) *Making the Ditches.*

In making the ditches the system followed is more or less the same on all the estates. On some estates the plan adopted is as follows: The main ditches, which are generally already made, are followed by the secondary ones, these by the irrigating ditches, and then come the various outlets, which comprise a variable number of furrows; at the end of the furrows is the ditch into which all the water runs, which flows into the main ditch, although sometimes the former takes the water direct to the next field. On other estates the furrows have no outlet for the water (collective drain), thus making a better use of the water. Up to the present we have met with no machines for making ditches. Some use ploughs for making the small ones.

Planting.

(*a*) *Class of Seed Used.*

Generally it is the cane tops that are used for seed, but a few use the body of the cane, and others use both indiscriminately. The seed is obtained in different ways: thus, some use the cane plant itself for seed, others the ratoon or second ratoon, and others again employ the old cane which is of no use in the factory, but some also choose from the field which contains the best cane. One estate takes into consideration the holes made by the borer in the seed, and as an aid to selection it takes into account the analysis, the juice and various other qualifications. On other estates they take no precautions whatever when selecting their seed.

(*b.*) *Preparing the Seed.*

The preparation of the seed is accomplished in different ways: thus, some use the top and cut off the end bud; others do not strip the top, but cut off the bud at the end; finally, there are others who neither strip the top nor cut off the end bud.

There are some estates which employ exclusively the body of the cane as seed. In this case it becomes necessary to cut the cane in twelve to fourteen months.

The size of the cutting ranges from forty to fifty centimetres on most estates, but on some they cut them as much as a metre long.

We have not seen the operation of disinfecting the seed on any estate.

(*c*) *Methods of Planting.*

Some sow in dry, others in damp soil. On some estates they cover up the cane altogether, and on others they leave outside the leafy part when they use the cane tops.

When sowing, the arrows are placed in a contrary direction to that of the current of water, and at the bottom of the furrow itself; on some estates they take the precaution of seeing that the eyes of the seed are laid sideways in the furrow. At the end of each furrow, on

nearly all estates, they put down two cuttings, which they utilize afterwards for replanting. When sowing in damp soil, after the cuttings are put down, they are trodden in so as to cover them up, but, when sowing in dry ground, they are covered up by the way they are put in. When cultivating on a small scale, in very damp soil, they plant on the ridge and not at the bottom of the furrow.

Weeding.

On most estates the weeding is done by hand with the spade. We have seen no mechanical appliances for carrying it out. Some landowners are studying this problem in order to see how they can best save labour.

On some estates they are trying to devise a means of avoiding the weeds as much as possible. Thus some allow the weeds to grow up till the time they become prejudicial to the cane, but as the latter is then sufficiently developed itself, it kills the weeds in consequence of the shade it casts on them. It is certain that if the landowners could plant their cane between the months of October and February inclusive, this operation might become less expensive.

Irrigation.

(*a*) *Procedure.*

On many estates the irrigation of the cane is accomplished by drainage, *i.e.*, the water is allowed to run right through the furrow, being collected afterwards in a collecting ditch which is used for the irrigation of a new division and so on successively until it flows back to the main ditch. On some others they irrigate without drainage, *i.e.*, the furrows are stopped up at the end in such a way that none of the water, which is run into the series, can get away.

As they are now using on some estates manures which are easily soluble in water, the waste of these fertilizers will decrease if the furrows are not drained, because only thus does it become a certainty that the manure is not carried away and remains in the furrow itself.

On one estate irrigation is effected on a small scale with punts. On another estate it is carried out in a zig-zag direction. We also had occasion to see an attempt made to get the water to flow through two furrows alongside the plants.

(*b*) *Number of Irrigations Required.*

The number of irrigations varies. The first and second ratoons are as a rule less watered than the cane plant. In one of the valleys where the landowners can command the quantity of water, it is admitted for fifteen and twenty days in succession during the period of floods, in order to obtain the sedimentary deposits contained in the water, which often leave a stratum ten centimetres thick. The cane plant on some estates receives as many as twenty irrigations, whereas the

first and second ratoons have as few as eight. In damp ground the cane only receives four or five irrigations, and in other soils it is not watered at all. As can be seen, no fixed rules can be given as regards irrigation, because these vary according to the soil, according to the quantity of water and the time of the year it is available. Many landowners suffer on account of deficiency of water; so that the cane cannot be systematically watered, and they are obliged to irrigate when the water comes and as best they can. This proceeding naturally affects vegetation and consequently the yield in general. As can be seen, the landowners may not fail to manure and cultivate on scientific principles, but the results they obtain are not in proportion to their exertions, simply through deficiency of water.

On some estates, on which the scarcity of water is notable, they have started to use filtered water, sinking ordinary wells and pumping up the water, and on others various sums of money have been spent, with a view to investigating the feasibility of obtaining water by means of artesian wells.

Hilling of the Cane.

On certain estates they hill the cane plant; on others this is not done. But all hill the first and second ratoons. In the latter case the earth is first of all removed with a Collins plough, when the cane plant has been hilled; or the soil is only removed when it has not been already done, and afterwards they are hilled with the deep plough. On other estates they hill with the spade by reason of the special form of the furrows, which does not allow the plough or the deep plough to enter.

Fertilizing.

(*a*) *How the Fertilizing is done.*

Some, but not all, of landowners fertilize the cane plants. Those who use fertilizers fertilize also the ratoons, but there are also a few who do not use them.

The following are the methods of fertilizing:—Some of the landowners simply throw the manure in the furrow and then cover it over with earth; others spread the manure in two lines marked out with the plough alongside the plants. This same method is adopted by some for their first and second ratoons, but others throw the manure on the soil after it has been turned over, and then earth up. Other landowners, at times, scatter the manure when it is used before planting. There are also some who occasionally cast the manure right into the furrow before sowing the seed.

The manure generally used is island guano; some are using concentrated potash fertilizers and bagasse ashes; others lime, gypsum, cachazas (scums), hypophosphates, but only on a small scale; others are making use of farmyard guano; and finally, there are also a few who employ saltpetre to bring on the plants.

(*b*) *Amount of Fertilizer applied.*

The quantity of guano used varies from two to eight tons per fanegada; of bagasse ashes from five to ten tons per fanegada. Some estates store up the guanos in heaps in the open, whilst others take them straight to the soil or else keep them in their respective bags. Some farmers intend to introduce mills for grinding up the guano and ashes.

The concentrated salts of potash are used in quantities of 200 to 600 kilos per fanegada, more especially sulphate of potash. Some mix these salts directly with the guano, the proportion of the mixture depending on the analysis of the composition and requirements of the ground. Some mixtures are in the proportion of 8 to 12% of salts of potash.

As a rule saltpetre, when used as a fertilizer, is applied in a small quantity. We are not aware that the landowners have applied salts of potash and saltpetre by means of the irrigation water.

The time for taking off the water to mature the cane some weeks before harvesting varies according to the estates and the soil. As on different estates the soil is not of an absolutely identical composition, some take off the water three or four months ahead, whilst others only require one or two. This operation varies also with the time of the year, it being of longer duration in winter than in summer. Moreover, the situation of the ground must be taken into account with respect to other ground under irrigation.

Cutting the Cane.

(*a*) *Time for Cutting.*

The time for cutting depends on the geographical and topographical situation of the district, and as a rule ranges from 16 to 24 months. The cane plant is ready for cutting a little later than the first and second ratoons. The time for cutting also depends on the climate, on the soil and on the water available. Sometimes the landowners cut their cane before it is ripe, but this practice is generally the consequence of a bad year, want of money, or on account of the rise in the price of sugar, or because the cane is very much attacked by insects. In some places in the valleys, where it is difficult to drain the ground, it is impossible for the cane to get quite ripe.

(*b*) *Number of Cuts or Ratoons.*

Some estates have two crops only, others three; others on an average, four; some have ground which has given 6, 7, and 8 crops, and in some small places the cane is from 25 to 30 years unchanged.

(*c*) *Cutting and Transporting.*

Previous to cutting the cane on some estates they burn the leaves. All the cutting in Peru is done by means of two gangs of labourers (peones): the cutters and the cane loaders. The cutting is done

with a hatchet in two blows, one for cutting the lower part and the other for the upper, not to mention one or two strokes for taking off the leaves. This cutting is a complex job and requires a great many hands. We have met with no machinery which might facilitate any of the cutting operations.

On some estates the operation of loading is done by the hands, whilst on others donkeys are used; the donkeys are also employed for passing the cane from small cars to large ones. It is conveyed in Decauville cars dragged by oxen, either from the field to the factory or just as far as the railway line, whence it is taken by locomotive to the factory.

The cars are filled with cane laid crosswise, but on some estates, the cane is cut in two, owing to the cars being narrow. It appears that the conveyance by carts has not as yet been adopted on any estate on the coast.

The cars used for conveying the cane have, as a rule, a platform of wood alone, or of wood with iron, or else of steel, and can take a load of one to eight tons. They have either straight or curved backs of wood, iron or steel, and as a rule are of only one type. The cars are of a four-wheeled type on most estates, but on some they run on two four-wheeled bogies.

All the cutting operations are paid by the piece, for which reason the cutters get on with their work and thus become very expert workmen at cutting and conveying.

The gauge of the railway, on some estates, is identically the same as that of the main line in the valley; on others it is different. There are both permanent and light railways on the estates. On some estates both classes of tracks are the same; on others the light portable ones are not so broad and in this case the small cars have to be unloaded into the big ones. There are also portable lines going right into the fields and on which cars drawn by oxen run to the permanent lines, or to the factory. The gauge of the lines varies from 0·60, 0·70, 0·80, 0·90 to 1 metre. The sleepers are generally of wood, but there are also some of steel and wood alternated.

Weighing and Unloading the Cane.

On some estates, there is a steelyard situated near the factory which weighs the cane in transit. There are a few estates on which the cane is weighed twice: once in the field, and again before going into the carrrier at the factory. The system of measurement is by pounds and kilos. On some estates there are recording steelyards.

Each car to be unloaded requires two men, and at the carrier from 8 to 26 are engaged. The unloading is done by hand, but on two estates they discharge the small cars direct into the carrier by simple mechanical means. On another estate an attempt was made with a mechanical discharger, but with no practical result.

Diseases of the Cane.

In all the valleys the Borer is found, an insect which pierces the cane and causes the invasion of a fungus which is harmful to the plant, most particularly where there is excessive moisture. The ravages of the Borer are considerable in some valleys and on some estates; while on others its ravages are not very extensive. On certain estates a worm is also found which cuts the leaves of the cane. Another enemy of the cane is the mouse, but as yet it is not dangerous.

Amongst the accidents happening to the cane is that of falling over, more especially with the white cane. On some estates this requires special attention, and propping up is resorted to, while on others this precaution is not taken. Another danger is the bad effect of the "bandara," the appearance of which originates from causes of very varied and complex nature, and which occurs sometimes long before maturity. Again the climate affects the cane when the duration of the seasons is abnormal, so that when winter begins very early or else is much protracted it is bad for the planting and delays maturity.

Scarcity of water is another event of note which affects the yield in general.

Experiments in the Country.

On some estates experiments in cultivation are being made as regards distances, planting, fertilization, and maturing. On other estates experiments are being made as regards pasture and forage for animals. They are making an attempt on one estate to grow lucerne alternately with cane. On certain estates it is intended to try machinery for weeding and for cleaning the ditches in order to keep them constantly clean; the same with the rills, particular attention being paid to the sanitation of the ground.

We give below the results of experiments made on one estate.

Experiments made for Comparison on one Estate.

Plot No. 1. Fertilizing materials used: Sheep guano and a mixture of Peruvian guano with sulphate of potash. (The mixture contained 5% of nitrogen, 7% of phosphoric acid, and 10% of potash.)

Plot No. 2. The same mixture of guano and potash and a little lime.

Plot. No. 3. Both this and those corresponding to Nos. 4 and 5 were made with samples of fertilizing substances produced commercially and which were sent on trial.

Plot No. 6. The same mixture of guano and potash.

Plot No. 7. Sulphate of potash.

Plot No. 8. Nitrate of potash.

Plot No. 9. The same mixture of guano and potash. The plot was only irrigated half as many times as the others, but the ground was cultivated after each irrigation.

Plot No. 10. No fertilizing material was applied.

Plot No. 11. Peruvian guano and bagasse ash.

Plot No. 12. The same as No. 11. It was reserved for peeling the cane.

Plot No. 13. Peruvian guano and bagasse ash. Care was taken that the cane was free from Borers.

Plot No. 14. Peruvian guano, bagasse ash, and a little nitrate of potash.

Plot No. 15. The same as No. 11. It was reserved for making two applications of the fertilizer.

Plot No. 16. Experiment of inoculation with a view to planting lucerne and cowpeas.

Plot No. 17. The same as No. 11, with a slight application of the mixture of guano and potash. The cane started to make breaks in the rows.

Plot No. 18. The same as No. 17. The cane was planted at double the usual distances.

Plot No. 19. The same as No. 17. The water passed between the rows and not through the cane which formed them.

Plot No. 20. Guano, bagasse ash, and chlorate of potash.

RESULTS OF THE EXPERIMENTAL PLOTS.

Plot No.	Height Metres.	Width.	Perforations.	Sugar. Per cent.	Fibre. Per cent.	Moisture. Per cent.	Weight. Kg.
1	1·765	3·5	26	15·96	15·10	66·80	2·00
2	1·625	3·2	10	14·80	16·00	66·70	1·40
3	1·340	3·3	7	17·67	14·50	65·50	1·90
4	1·485	3·3	2	16·20	15·80	65·00	1·70
5	1·845	3·2	12	17·20	14·20	66·10	1·90
6	1·445	3·2	5	15·58	14·40	67·20	1·50
7	1·410	3·1	4	15·39	14·10	67·50	1·50
8	1·760	3·5	12	14·30	16·00	66·00	2·20
9	1·465	3·25	1	15·20	14·40	67·20	1·60
10	1·260	3·3	6	14·00	14·20	67·10	1·50
11	1·840	3·3	12	13·49	16·50	66·72	2·20
12	1·585	2·9	18	15·20	15·85	66·00	1·90
13	1·920	3·5	13	16·72	15·90	64·90	2·00
14	2·410	3·3	14	14·26	17·41	65·70	2·60
15	1·670	3·2	14	14·25	16·40	66·50	1·20
..	....	..	..	....	....	....	....
17	2·045	3·2	32	16·34	16·10	65·00	2·00
18	1·970	3·3	16	15·58	16·50	65·20	1·90
19	2·130	3·2	15	15·50	15·60	66·50	2·10
20	2·155	3·5	30	15·58	15·70	66·20	2·10

It is announced that the Cuban import duties on "sugar machinery and apparatus for making sugar and brandy" have been altered and are now only 10 per cent. *ad valorem*. The new rates came into force a month ago.

SUGAR PRODUCTION IN THE PHILIPPINES.

The cultivation of sugar is, with the exception of Manila hemp, the most important branch of agriculture in the Philippine Archipelago, and until about twenty years ago surpassed even that product in economic value to the islands. Among the various regions in the Philippines that have taken up the cultivation of sugar cane, the most important is the group of islands to the south of Luzon, known as the Visayas, and among these the island which has acquired the greatest prominence in the industry is Negros, which produces more than one-half of the entire amount raised in the Philippines. There are many causes that have contributed to the development of cane raising in the Island of Negros, but the fertility of its soil and its peculiarly suitable climate are undoubtedly the most important. Other factors favouring the development of its agriculture have been the personal security which has existed for a long time in this island, and the abundance of labour, as well as the abundance of horses, which are very useful, even at present, to the farmers in the Philippines.

It may be stated that sugar cane is exotic in the Visayas, and although there are no historic data to prove its introduction by the different colonies established on the south-west part of the islands, it is very probable that this plant was introduced by the Chinese who gave a great impulse to its cultivation in the Philippines, as shown by the etymology of the names of the various articles used even now by the Filipinos in the production of sugar, as well as the similarity of the manufacturing processes used of old in these islands and in Formosa. It is very likely that the Chinese introduced some of the varieties of sugar cane which were cultivated in Formosa, but even at that time the plant was already known in the Visayas, as well as when the Spanish Government imported some of the American varieties. Of all the different kinds of sugar canes produced in the Philippines, the purple variety is the one most generally cultivated at present in the Visayas, either because it is better adapted to this soil, or because it produces the largest amount of sugar.

The methods of cultivation used by the great majority of planters in the Philippines are practically the same, but are quite different from those employed in this industry in the adjacent island of Java and in the sugar producing regions of America. Philippine methods are, as a rule, antiquated, almost prehistoric, both in regard to the cultivation of the cane and in the manufacturing process. The industry may be said to be in its infancy in the Philippines, as the planter has not even succeeded in becoming independent and has to be both farmer and manufacturer. There is not a single sugar factory in the entire region of the Visayas; that is to say, a central

factory provided with modern and improved machinery, and therefore each farmer has to turn the cane into sugar by his own labour, which explains the poor condition of the sugar industry in the country. When the Americans took possession of the Philippine Islands it was thought at first that the farming industry would be greatly improved by the introduction of new methods and improved machinery for the cultivation of the cane and the production of sugar, and also that some central factories would be built and various small plantations united; but, unfortunately, up to this time, the Americans have done absolutely nothing for the betterment of the sugar industry, either by furnishing industrial, intellectual, or monetary elements, or by helping the planter directly or indirectly. In view of the fact that the insular government has taken no interest whatever in the colonization of and the gradual restoration of agriculture in the entire Philippine archipelago, the United States Government has decided to guarantee an interest of four per cent. to the Agricultural Bank, which is about to be established in this colony. Owing, however, to the small capital of $10,000,000, in Philippine money, with which the bank will be started, and to the strict laws prevailing in regard to loans on agricultural property, it is hardly to be expected that this bank will be a very important factor in the development of sugar production in the islands.

The soil most generally suitable for the cultivation of sugar cane is to be found on the high and very gradual slopes, having a sufficient amount of moisture with good drainage, and free from vegetation or roots of other plants. The planting season extends from November to January, when the danger from typhoons or storms is over. The cane reaches its complete development in twelve to fourteen months on a good soil, whereas it takes from fifteen to eighteen months on virgin and other lands which have not been thoroughly tilled.

There are very few plantations that will produce five crops in succession from shoots, but on a very good soil it is possible, and even common, to obtain four crops from a single planting. In the majority of cases the planting is done by means of cuttings, using for the purpose the parts of the cane containing little sugar. The result of this practice is that the growth of the cane is stunted and the plants degenerate rapidly. The average production in the Philippines from land properly tilled, according to Philippine methods, is from one to one and a half tons of sugar per acre, which is the smallest average in the entire world, both for cane and for beet sugar. The operation of cutting and carting the cane is done by means of animal power, as there are very few plantations having railroad tracks for the transportation of the cane to the mill. When a part of the cane has been stored in the shed of the mill, the operation of grinding begins and is carried on for from one to three months, according to the amount of cane collected and the interference from rains.

The grinding process used in the Visaya Islands is not only very slow but highly wasteful to the planter, as it leaves in the cane from 30 to 35 per cent. of the juice, which has to be evaporated in order to use the bagasse for fuel when dry. The boiling is done in pans in the open air, and the waste by this process is as large or even larger than that from the grinding. Complete ignorance of chemistry on the part of the farmer is another cause of the poor quality of the sugar produced in the Philippine Islands. It may be said that in the entire region of the Visayas there is not one chemical laboratory in which the most simple operation pertaining to this industry could be performed in a scientific manner. In regard to the study and the analysis of soil used for the cultivation of cane, and for experiments with new systems of cultivation, the same conditions prevail.

When the sugar that has been boiled in the open pans thickens and cools it is packed in bags made from the leaves of the plant called guri. These bags contain from 80 to 100 pounds of cane each, and when filled they are reinforced with reeds and then they are ready for shipping to the market of Iloilo on launches carrying from 1000 to 2000 bags per trip. Merchants in Iloilo classify the sugar according to quality, making it No. 1, 2, and 3, damp and ordinary. This classification is made in the rule-of-thumb way, inasmuch as No. 1 shows 87 degrees on the polariscope, and it is very seldom that one can see No. 0 sugar showing a polarization of over 92 degrees, and the merchant mixes a very small amount of the latter with No. 1 for the adjustment of prices. Prices are as a rule quoted on assorted sugar, the type for which refers to a certain amount of sugar that is formed from the three first qualities on conventional proportions. The unit of weight used for all sugar transactions in the Philippines is the "pico," equal to 137½ pounds.

In Iloilo, which is the main sugar centre in the Visaya Islands, are the merchants to whom the planters sell their sugar, either for local consumption or for export. The exporting firms are mainly Chinese or English, whereas the merchants who buy from the planters and sell to the exporters are Spaniards or Filipinos. Sugar plantations are as a rule managed by Spaniards, most of whom come from the northern provinces. There has always been a very close relation between the merchants of Iloilo and the farmers of the Visayas. Three firms have especially distinguished themselves by the interest they have taken in the development of the agricultural industry at all times and circumstances—the old English firm of Loney & Co., the American firm of Russell & Sturgis, and the Spanish house of Inchausti & Co.

The best year known for the sugar industry in the Visaya Islands was undoubtedly that of 1892, which in the port of Iloilo alone the exports amounted to 2,600,000 picos, whereas in the year 1900 they

hardly reached 500,000 picos. The change of ownership of the islands, the emigration of capitalists, the damage caused by the last insurrection, and the mortality of cattle were the main causes for this enormous decrease in the production of sugar. As peace is reestablished and personal security becomes assured, work on the farms, which had been abandoned by their owners, is being started again, so that in the year 1905 the entire crop of sugar in the Visayas amounted to 1,140,000 picos, and during the season of 1906 it rose to 1,718,000 picos. The crop of 1907 is estimated at about 1,600,000 picos, that is 100,000 tons, notwithstanding that many plantations were devastated by locusts and the scarcity of cattle for tilling the land and other farming operations. Up to about ten years ago sugar from the Visayas was exported mainly to England and the United States, but since the Americans took possession of the islands, China and Japan have been the best markets for the sale of this article. For instance, in the year 1892 there were exported from Iloilo over 2,000,000 picos for the United States and the British Islands, whereas to China the exports were hardly one-fourth of that amount. On the other hand, in the year 1901 exports to China were ten times larger than the exports to the British Islands and the United States. The exports of sugar to England have ceased entirely because the Hong-Kong market pays better prices and therefore many Chinese and English firms have taken up the export to the latter country. Japan is taking gradually increasing amounts, but its importance in the market of Iloilo is as yet only secondary. The United States, which ten years ago was such a good market for the sale of this sugar, does not offer, at present, any margin of profit on account of its high duties, which makes it impossible for us to compete with the sugar from other markets. This notwithstanding, in the year 1906, we exported to the United States over 180,000 picos, against 1,500,000 which were exported to China and Japan. If the tariff is removed on behalf of the Philippine planter it is to be hoped that the exportation of the main product of the Visaya Islands to the United States will increase very rapidly.

With the construction of railroads in the Visayas a rapid development is to be expected in the sugar industry of the Panay and Negros Islands, as they will open to cultivation all the virgin and waste lands of that region, as up to this time the cultivation has been limited to those lands that are near the coast or navigable rivers, owing to the lack of means of transportation for the product of other sections. The port of Iloilo, where vast improvements are now being made, will derive great benefit from the construction of the railroads and it is to be expected that in about ten years its exports of sugar will be doubled if peace continues and any favourable laws are enacted. The American government would be entitled to the everlasting gratitude of the inhabitants of the Philippine Islands by repealing the part of the

tariff affecting the exportation of sugar from these islands. The repeal of this part of the tariff has been discussed a number of times in the United States Congress, but the proposition has always met with the argument that if Philippine sugar were to be admitted free of duty in the states, the corresponding home industry would be ruined. Nothing could be more fallacious than this theory. In olden times when the production of sugar used to cost \$1·50 per pico of 122½ pounds, the Philippine sugar was exported in large amounts to North America and there is no record in its industrial history of any damage caused by this importation to the domestic industries. If competition from this source was not so injurious when the islands could produce their sugar at such small cost, there is no reason why any harm should come to-day when the production of sugar in the Philippine Islands costs more than double. The scarcity of competent labour in this line of agriculture, the antiquated methods employed by planters and the shortage of cattle and of monetary resources, all combine to prevent any advancement in this important industry of the archipelago. Once that the money in circulation has increased, the mortality of of cattle ceased, and the Filipinos become convinced of the advantages of depending on their honest work for a living, the production of sugar will become a prosperous industry, inasmuch as the Visayas are wonderly favoured by natural conditions both in regard to the climate of this tropical region, the fertility of the soil, and the geographical position of the islands.—(*Dun's Review.*)

Three Lillie quadruple effets are at present at work at the Guanico Centrale, Porto Rico, each of a capacity to concentrate 400,000 gallons of cane juice 75% of its volume per 24 hours, a total of 1,200,000 gallons juice. In these quadruples the direction of the vapours can be reversed at will, any effet can be cut out for repairs, and the quadruple can be instantly converted into two double effets, thus nearly doubling the capacity of the apparatus in cases of emergency.

The Greenock Harbour Trustees have lately contested the right of the Judicial Factor, who represented the Debenture Stock Holders of the Harbour, to raise the harbour rate for sugar from 10d. to 1s. 3d. per ton, and the Court of Session, Edinburgh, has given a decision in their favour, declaring that it was not within the power of the Judicial Factor to raise rates at his own hand. This decision will be welcomed by the Greenock sugar trade who would otherwise have been seriously affected, and it is hoped that it will not be reversed on appeal.

THE WEST INDIAN AGRICULTURAL CONFERENCE, 1908.

(Continued from page 143.)

The Hon. Francis Watts (Leeward Islands) gave a summary of the results of the experiments that have been carried on with seedling and other canes in Antigua and St. Kitts. It was stated that the inability to raise a large number of seedlings in Antigua and St. Kitts was due to the fact that very high, dry winds, and frequently drought, prevailed at the time when the canes were arrowing. They, therefore, were dependent upon supplies from the experiment stations in British Guiana and Barbados. The row method of experiments was adopted for testing new varieties of canes before introducing them into cultivation on a large scale. This method had proved satisfactory, and large areas of seedling canes are now planted in Antigua and St. Kitt's. It was stated that 26% and 71% respectively of the total sugar producing areas of these colonies was occupied by seedling canes. Manurial experiments had been conducted. They show conclusively that artificials are not to be recommended for application to plant canes if the ordinary application of farmyard manure is given. The experiments with ratoons are divided into two series, and the results are published annually in pamphlet form and in the large reports by the Imperial Department of Agriculture.

He next read a paper on the results of the Central Sugar Factory in Antigua, which showed that this factory was successfully worked on co-operative lines and was making a substantial profit. Estates other than the original contractors were anxious to sell their canes to the factory. In answer to enquiries he expressed the opinion that unless factories were run on co-operative lines, in countries where muscovado sugar was chiefly made, there was little likelihood of success.

This factory was erected as a pioneer one designed to solve the much-debated question of whether it is prudent or desirable, under the conditions in the Leeward Islands, to abandon the muscovado method of sugar manufacture for the methods of modern factories. In 1907, the season just ended, 4,230 tons of sugar have been made from 40,782 tons of canes, as compared with 2,348 tons of sugar from 24,676 tons of canes in 1906, and 1,634 tons of sugar from 15,860 tons of canes in 1905. The position of the original contracting proprietors may be summed up as follows:—they have sold 62,274 tons of canes and have received £28,501, or 9s. per ton by way of first payment, and £7,367, or 2s. 4d. per ton by way of cash bonuses; making a total of 11s. 4d. per ton of canes, and have invested £3,341 or 1s. 0¾d. per ton of cane in the factory. The A shareholders have received 5 per cent. interest on their money and, in addition, cash bonuses of £5,115, equal to 20·4 per cent. in three years on the capital invested by them or 6·8 per cent. per annum. This is equivalent to 11·8 per cent. per annum in all and, in addition, there is the investment in the factory

of £3,341 out of the profits, equal to 4·4 per cent. per annum. It is also worth noting that 11s. 4d. per ton of canes is equal to 5·6 lbs. of 96° sugar per 100 lbs. of cane.

In course of the discussion that ensued, the Hon. F. J. Clarke (Barbados) asked whether there were many outside the original contractors who sent their canes to the factory, and at what rate were they paid.

Hon. Francis Watts replied that there were many estates which now sold their canes on a basis of 5½ lbs. of sugar per 100 lbs. of canes, which worked out at a little under 11s. 4d., and they were perfectly satisfied to sell their canes at that rate.

Hon. F. J. Clarke said that the conditions must be vastly different in Antigua from what they were at Barbados, because three years ago when the figures in connection with the Antigua factory were published, some of the planters in Barbados took the trouble to weigh their canes, go into calculations, and make comparisons with the figures of the Antigua factory. They found that with their muscovado process they did very much better than that factory, and had realized fully 14s. a ton for canes. He had been furnished with statistics by several planters who weighed their canes, and in every case they had found that they would have lost considerably by selling their canes to a factory at the prices paid at Antigua.

Hon. Francis Watts was of opinion that for the planter to get good value for his canes the factory must be worked on the co-operative principle.

The President pointed out that this point was specially emphasized in the report of the Royal Commission, and until they could get a co-operative factory working in Barbados and owned by the people themselves, there was little chance of the aspect of things being materially altered.

Hon. B. Howell Jones asked whether the canes should not be paid for by content rather than by weight, as the sugar content of the juice of the sugar cane varied considerably.

Hon. Francis Watts thought that so far satisfaction was felt as to buying canes by their weight.

Hon. Francis Watts next gave a summary of a paper, under revision, on "Observations on the work of sugar cane mills, and deductions to be drawn therefrom." Here it was suggested that the efficiency of a mill may be accurately measured by ascertaining the proportion of juice remaining in the megass in relation to the fibre; in other words, the quantity of first mill juice per 100 parts of fibre.

This factor permits of the comparison of mills working under the most diverse conditions, either of the quality of the cane or juice, or of the character of the mills. Comparisons can be made between mills grinding either good or indifferent canes: it is immaterial whether maceration is used in one of the mills under

comparison and not in the other—it even applies to such methods as the Naudet process wherein the megass is discharged, saturated with water. A direct comparison can also be made between any mill and the Naudet process irrespective of the quality of cane handled by each. Similarly, a single mill in a muscovado sugar works may be directly compared with a modern mill using maceration. It is of no consequence what quality of cane either mill deals with.

Professor Carmody (Trinidad) read a paper on "Further notes on cane farming in Trinidad" giving statistics which showed the progress that had been made in the industry during the last two years; the number of cane farmers had increased to 328; 17,000-20,000 acres were under cultivation, and the number of farmers was still on the increase, the East Indian increasing more rapidly than the West Indian. The yield of canes was regarded as fair and it was thought that cultivation of sugar-cane by farmers in co-operation with central factories was proving to be highly satisfactory. The stability of the sugar industry in Trinidad relied greatly upon the co-operative system of production.

Hon. Howell Jones said that very little cane farming was carried on in British Guiana, the difficulty being the means of transport between the various villages and the estates.

Hon. Francis Watts said that the basis of trading in Antigua was somewhat different to that described by Professor Carmody, although the effect might be somewhat similar. Peasants' canes were bought at the rate of 4½ lb. sugar per 100 lb. cane, which during last year realized 8s. 7½d. per ton of canes. He was unable to say how many acres there were in farmers' canes.

Hon. W. Fawcett (Jamaica) said there was a small amount of cane-farming going on in Jamaica at Westmoreland, where one or two small estates had abandoned their machinery and were selling their canes to larger estates. But there were no peasant farmers as in Trinidad.

Mr. F. A. Stockdale (Mycologist on the staff of the Imperial Department of Agriculture) read a review of the root disease of the sugar cane caused by *Marasmius sacchari*. Of the fungus diseases of sugar cane of the West Indies, this disease is considered to be the most important, and has probably caused more damage during the past few years than all other sugar cane diseases together. A brief summary of the advance of knowledge of root disease of sugar cane was given and attention was drawn to the efforts that were being made in other sugar-producing countries in fighting similar diseases. Instances of considerable losses throughout the West India islands were cited, with a view to bringing forward the necessity for more thorough adoption of remedial measures. The root disease does damage in two ways: (1) It destroys the roots of plants and ratoons, and (2) it smothers the new shoots of ratoon stools. The symptoms

of the disease were briefly referred to, and it was pointed out that it spread by three methods: (1) by the spores borne by the small toadstool-like fructifications; (2) by the mycelium that travels underground, and (3) by the planting of affected cane-cuttings. In discussing remedial or preventive measures, Mr. Stockdale stated that they may be divided into (1) cultural improvements, (2) sanitary measures, and (3) selection of varieties. The question of rotation of crops was fully dealt with and the best methods of disposal of infected material—such as rotten canes or trash—were brought forward. Attention was also drawn to soaking cane-cuttings in Bordeaux mixture, and to the value of lime as a fungicide. It was brought to notice whether the good results that accrue, in many sugar-producing countries, from applications of lime are really due to the indirect manurial action or clay-flocculating effect, or whether they are not rather due to a considerable extent to the action of lime on the parasitic enemies of the sugar cane. The use of lime on sugar lands in Hawaii has recently been on the increase and it has been mentioned that lime and cow peas have been shown to be suitable treatment from a manurial point of view for many of the cane soils of Jamaica. Experiments might therefore be started throughout these islands with applications of lime, and the results viewed from a mycological rather than a manurial point of view. Experiments conducted along the right lines might answer the question as to the fungicidal value of lime in the root disease of sugar cane. Disease resistance of many of the seedling varieties was touched upon, and satisfactory progress in connection with the breeding of hybrid canes for disease resistance reported. In Java where the root disease was first worked at by scientists, it is reported that Mr. Prinsen Geerligs states "that it is now difficult to find specimens of the root fungus in Java." The system of rotation, with the elimination of ratoon crops, and the great care taken with material for planting purposes have played an important part in bringing about this result.

Hon. Francis Watts briefly reviewed the situation of root disease of sugar cane in the Leeward Islands. He drew attention to the soaking of cane cuttings in Bordeaux mixture. Mr. Bovell illustrated his remarks by reference to specimens of cane cuttings brought to the Conference, and Hon. F. L. Clarke, Mr. Cowley, the President, and Mr. Stockdale joined in the discussion.

The paper entitled "Selective Cane Reaping at Jamaica," which was prepared for the last Conference at Jamaica and published in the *West Indian Bulletin*, Vol. VIII., p. 109, was referred to. In ratooning districts, it was stated that good results followed the cutting of only the ripe, mature canes, and recommended itself for trial instead of "cutting clean," in places where ratooning is carried on for any considerable length of time.—(From the *West Indian Bulletin.*)

THE SPANISH SUGAR INDUSTRY.

The Commercial Attaché to His Majesty's Embassy in Madrid in a report on the trade of Spain during 1906 gives a detailed description of the Spanish sugar industry and the working of the Sugar Trust lately formed. We reproduce below this portion of his report, with the addition of some equivalents in British weights and values to make it the more intelligible to our readers.

The rates of duty on sugar in Spain are as follows:—

	Amount. Pesetas	c. (gold)	
Import duty per 100 kilos.	85	00	
Currency at present exchange	85	85	
Consumption duty	25	00	
Protection per 100 kilos.	60	85	(23s. 10d. per cwt.)

This high protection has led to the usual results—the formation of a combine, under the name of the Sociedad General Azucarera de España (formed in 1903). Unfortunately for itself, but fortunately for the consumer, some factories remained outside the ring; and owing to the absence of the necessary preventive clauses, some owners of factories having sold their out-of-date establishments to the combine at fancy prices, established with the proceeds of their bargain new factories with the latest improvements in machinery to compete with the monster they had assisted in producing. Then came over-production and the cutting of prices, and the Sociedad General is left at the close of the sugar season, 1905-06, with a net profit of 900,000 pesetas (£35,678), on a capital of 143,000,000 pesetas and 52,000,000 pesetas in debentures.

In the Vega, or Plain of Granada, the several factories existing were bought up by the Sociedad General at the time of its formation, one—the San Isidro—alone keeping out. Now there are four free factories among the dozen or so factories in the district; that is to say, three have been erected since the Trust was formed.

The free factories are in a much better position to stand the losses resulting from competition than the Sociedad General for the following reasons:—(1) Delay in getting orders filled by the Sociedad General, owing to the necessity of their going through the Central Office in Madrid; (2) public antipathy to a society whose object is monopoly; (3) over-capitalization of Sociedad General; (4) control of free factories over beet supply, owing to their co-operative system.

The co-operative system of the free factories is briefly as follows:— The capital is subscribed by shareholders who receive a fixed dividend of 5 per cent. or 6 per cent. on their money. Their position corresponds to that of preference shareholders in a British company. In addition to these shares there are Acciones de Romolacha or beet shares, the holders of which are bound to provide so many tons of beet per share

at a price fixed at the beginning of the campaign. Any profits available after meeting expenses, the 5 per cent. dividend, &c., are divided among the holders of the beet shares in the shape of an increase on the price paid for their beets. If the beet shareholder fails to carry out his contract he forfeits his share for the year in the profits of the company, or in some cases pays a fine proportionate to the shortage of his contribution. In the same way, if the company's working shows a deficit, a deduction is made from the amount originally credited to the grower for his beet. This system—copied from the San Isidro factory by the other free factories—has given them a control of the beet crop, which the Sociedad General are too weak to be able to wrest from them.

Nearly all the sugar machinery in the Granada district was supplied by the Fives-Lille Co.

The stages by which the protection on sugar has grown up are as follows:—

Customs Duties imposed by Budget Law, 1892.

	Amount.			Per cwt.	
	Pesetas.	c.		s.	d.
On foreign sugar, per 100 kilos.	50	00	..	20	0
On Spanish Colonial sugar	33	50	..	13	4
Manufacturing tax on home sugar	20	00	..	8	0

For assessing this latter tax the sugar contents of cane and beet were taken as 5 per cent.—a very low estimate.

When Senor Villaverde required further revenue in 1899 the manufacturing tax was raised (by the law of December 19, 1899) to 25 pesetas per 100 kilos., and the customs duties were raised to 85 pesetas, the margin of protection being therefore 60 pesetas per 100 kilos.

The sugar manufacture in Spain is said to represent 300,000,000 pesetas invested capital besides almost an equal amount invested in the agriculture connected with it. It is, therefore, natural that great public interest should be evinced in the negotiations which have been proceeding for many months past, and in the Bill introduced by the late Liberal Minister of Finance, Senor Navarro Reverter, for facilitating the existence of existing refineries. The Sociedad General who, with their over-capitalized business are the greatest sufferers, maintain that the distress is due to over-production, and in support of their views give the following figures for stocks held in recent times:—Refiners, 44,779 tons; merchants, 24,000 tons.

The free factories combat this, and state that any large stocks in the hands of refiners may be attributed to the shyness of buyers, who have always been waiting for lower prices during the long-continued struggle between themselves and the Sociedad General, and that it is not a chronic state of affairs. The Sociedad General maintain that the stock would have been even greater had they not shut down some of their factories in order to keep it down, while the

free factories explain that they did so because they could not get sufficient beet.

Of the free factories, that at Malaga, which is the most important refinery of cane, is said to be the most anxious to come to an agreement, for Spanish sugar cane gives only 9 per cent. sugar as compared with 12 to 12½ per cent. by Spanish beet, and as the former is exposed to frost and is more costly to refine, it is to the advantage of this factory to see the cutting of prices ended.

The production of sugar in Spain is given by the *Liste Générale des Fabriques de Sucre, 1907*, as follows:—

Year.	Quantity. Tons.
1905-06	95,000
1904-05	96,720
1903-04	113,842
1902-03	96,160

The basis for the negotiations between the 55 sugar factories belonging to the Sociedad General and the 20 free factories was an apportionment between the two groups of the total home consumption, and the difficulty in coming to an agreement on this point has always been the stumbling block. The Sociedad General adopted as basis for the suggested distribution 101,000 tons, which is the potential capacity of its 55 factories, of which, however, 20 are shut down, and which in 1905-06 only produced 55,000 tons. To this figure of 101,000 tons it added the 36,500 tons produced in 1905-06 by the free factories, all of which were working.

If the Bill which was introduced by the Minister of Finance in November, 1906, which is referred to later, had become law, these discussions would be of only academic interest, but that Bill was subsequently withdrawn, and it is now again left to the manufacturers to settle matters among themselves. The longer such a settlement is postponed, the more difficult it will be to reach, because during the last season the free refineries increased their production and will, therefore, require a higher proportion of the total production assigned to them in any future agreement.

The Bill introduced in November, 1906, for regulating the production of sugar contained clauses to the following effect:—(1) Excise on sugar to be 20 pesetas per 100 kilos. net; (2) no sugar factory or mill to be erected in future within 80 kiloms. of any existing factory; (3) any factory not producing during five years shall be considered as non-existent for purposes of the above clause; (4) the Government will apportion annually to each factory its share of the whole production; (5) if any factory exceed the amount, its portion for the ensuing year shall be reduced by the amount of its excess.

The effect of Clause 2 is, generally speaking, to give each existing centre of manufacture a protected zone of 40 kiloms. radius as regards sales, *i.e.*, the protection from a factory 80 kiloms. off consists

in the advantage as compared with that factory in the cost of transport to any point within that radius. Beyond that radius the competing factory would get the advantage.

But its most important effect seems to be to restrict the competition in each zone for the produce of the beet growers, who have been benefiting by the competition between the Sociedad General and the free factories for the raw material.

In this connection attention may be called to the important contracts for chemical manures made annually by the Sociedad General, who advance manures to the growers against the future delivery of their produce.

The present prices of the Sociedad General are:—

	Price per 100 kilos. Pesetas	c.		Per cwt. £	s.	d.
Pilé	94	50	..	1	18	2
Granulado	96	00	..	1	18	9
Blanquilla	94	00	..	1	18	0
Refinado	117	00	..	2	7	2

The wholesale business in Madrid is in the hands of some ten merchants, who do not seem to have been able to come to any arrangement for regulating prices. The consumer is therefore getting some advantage from the competition of the manufacturers.

The average retail price of lump sugar is 1·50 pesetas per kilo. (7½d. per lb.), and powdered sugar 1·20 pesetas per kilo. (6d. per lb.).

With a view to improving their power of competition, some manufacturers are adopting measures for making the best use of their by-products by making molassine and other preparations for cattle food. The Sociedad General are making compressed cake, and are exporting a certain quantity to the United Kingdom.

The following are the figures for recent sugar seasons:—

BEET.

	Quantity. Tons.
June 30th, 1905, to July 1st, 1906—	
Stock of sugar—	
July 1st, 1905.	22,774
June 30th, 1906.	28,885
Beet entered July 1st, 1905, to June 30th, 1906..	678,049
Sugar manufactured	77,768
January 1st, 1905, to December 31st, 1905—	
Stock of sugar—	
January 1st, 1905..	54,614
December 31st, 1905	48,316
Sugar manufactured..	68,965
January 1st, 1904, to December 31st, 1904—	
Stock of sugar—	
January 1st, 1904	49,056
December 31st, 1904	54,614
Sugar manufactured	78,735

NOTE.—Percentage of sugar to beet, 8·7.

Cane.

	Quantity. Tons.
January 1st, 1905, to December 31st, 1905—	
Stock of sugar—	
January 1st, 1905	8,358
December 31st, 1905	8,063
Cane entered January 1st to December 31st, 1905	309,152
Sugar manufactured	28,820
January 1st, 1904, to December 31st, 1904—	
Stock of sugar—	
January 1st, 1904	1,066
December 31st, 1904	8,368
Sugar manufactured	22,175

Note.—Percentage of sugar to cane, 10·7.

Refineries.

	Quantity. Tons.
Stock of refined sugar—	
January 1st, 1905	1,894
December 31st, 1905	1,817
Refined during year	8,058

The sugar tax is estimated to give a revenue of 23,000,000 pesetas in 1907.

The following table shows detailed expenses of the cultivation of beet per superficial unit of 1 hectare:—

Cultivating Operations.	Cost per Hectare. Pesetas.
Three preparations of soil and pruning	100
Wages, 7 men for digging and levelling ground	14
350 kilos. of superphosphate and 100 kilos. of sulphate of potash (in autumn), 250 kilos. of nitrate of soda (in spring) and sowing	150
Wages—	
5 men for uprooting plants	10
3 men for carrying to planting plot	6
20 women and boys preparing plant and planting	21
14 men for transplanting	28
26 men for tilling ground (shallow digging)	52
4 men for weeding	8
Irrigation	30
3 teams of oxen for uprooting	24
Wages—	
60 men for preparation roots	75
5 men helping load carts	10
Carriage to factory at 4 pesetas per ton	102
Rent and general expenses	170
Total expenses	800 or

say £12 16s. 9d. per acre.

Note.—The foregoing expenses are based on the cultivation of second class ground, being reduced by 50 pesetas per hectare for first class ground and increased by 50 pesetas for third class ground.

The following table shows the cost of manufacture of sugar per unit of 100 kilos. :—

	Cost per 100 kilos. Pesetas	c.
Wages, comprising wages for repairs to factory..	6	00
Coal..	6	00
Limestone	0	35
Sacking	1	40
General expenses of manufacture	3	25
Beet, based on yield of 10 per 100	42	00
Total	59	00
Revenue tax	25	00
Working expenses, administration, &c..	5	00
Grand total	89	00

NOTE.—100 kilos. $= \frac{1}{10}$ of a metric ton of 2,204 lbs.

ABSTRACTS, SCIENTIFIC AND TECHNICAL.*

THE POLARIMETRIC DETERMINATION OF SUCROSE. *F. Watts and H. A. Tempany. Jl. Soc. Chem. Ind., 1908, 27, 53-58.*

In the polarimetric determination of sucrose in raw sugars, the most suitable and convenient method of defecation is by means of basic lead acetate. Formerly, solutions of the acetate were used, but it has been shown that by this means errors of concentration were introduced, owing to the space taken up by the precipitate formed. Horne proposed the use of the anhydrous acetate in place of a solution, as almost removing this source of error, and in a former paper the authors supported this contention by further experimental work. Some investigators, however, still maintain that there is a serious error in the polarimetric readings caused by the direct action of the basic acetate on the invert and non-sugars present. It is shown in the present paper, that in ordinary raw sugars, if only a slight excess of the basic acetate is used, the error is so small as to be negligible. If a large excess is used the error becomes serious. The authors consider that the error in reading is due to the basic portion of the lead present, and they show that if sufficient acetic acid is added to just neutralize the basicity, the normal reading is restored. In the determination of molasses, however, the quantities of basic acetate required are so large that the error is considerable. A greater approach to accuracy, than that usually attained, may be got by clarifying with dry basic lead acetate followed by sulphur dioxide; this is particularly so with regard to determinations by Fehling's method. In raw sugars clarified by basic acetate of lead, the primary

precipitates contain from 50-60 per cent. of lead oxide, the basic acetate itself containing 81·4 per cent. The clarified liquor almost always contains lead, but generally gives a further light lemon-yellow precipitate on the addition of more basic acetate. This precipitate was found to contain 81 per cent. of lead oxide and a smaller amount of organic matter apparently of a pectinous nature. The authors believe the lead present in the clarified juice to be due to traces of organic lead salts arising from the interaction of the organic acids present in the sugars with the basic lead. They have investigated the influence of these traces of lead salts in the clarified juices on the determination of invert sugar by Fehling's solution, and find that it is so slight as to be negligible unless a large excess of basic oxide has been used.

Some Observations on the Keeping Power of Fehling's Solution, together with Notes on the Volumetric Process of Determining Sugars with it. *F. Watts and H. A. Tempany. Soc. Chem. Ind., Ordinary Meeting, January 6th, 1908.*

The authors point out that, contrary to the commonly expressed ideas, Fehling's solution, or at least Violette's modification of it, is not liable to deteriorate rapidly if kept in the dark, and if access of air is prevented. The solution can thus be kept mixed ready for use for many months, and it is not necessary to keep the stock in the form of two solutions to be mixed as required.

The actual titration is as follows: 10 cc. of the Violette-Fehling's solution are measured into a small beaker of about 100-150 cc. capacity, and to it is added an equal quantity of water. The solution is brought up to boiling on a sand-bath, and the reducing sugar added from a burette until the blue colour of the liquid is no longer visible. The end-point of the titration is determined by filtering drops of the solution on a small specially arranged pad of filter-paper. A sheet of specially toughened filter-paper forms the top layer; this is placed on two sheets of filter-paper of rough fairly open type; these layers of filter-paper are then cut into squares of about 1 cm. The liquid to be tested is dropped on the hardened filter-paper and allowed to soak through the three layers; the two upper layers of filter-paper containing all the precipitated cuprous oxide are rejected, and the spot of liquid on the lower one is tested for unreduced copper with ferrocyanide and acetic acid.

As a result of a large number of determinations the authors find that when sucrose is present, each gramme dissolved in 100 cc. of the solution under examination possesses a reducing power equal to 0·0033 gramme of invert sugar dissolved in the same volume, and they advocate the use of this factor by way of correction of the amount of invert sugar determined in the presence of known quantities of

sucrose. It is shown that in the absence of this correction the amount of invert sugar determined by Fehling's solution, in such cases as that of sugars, may be seriously in error.

In the discussion which followed the reading of the paper, Mr. A. R. Ling expressed surprise that the authors had ignored the use of ferrous thiocyanate as an indicator (Ling & Rendle, *Analyst*, 1905, **30**, 182-188), this having been shown to be superior to any other suggested for the purpose. He presumed that the authors in stating a constant value for the influence of cane sugar, were dealing with mixtures containing very small proportions of invert and very large proportions of cane sugar. He would shortly publish experiments on this point, and show that the influence of cane sugar on the estimation of invert sugar depended upon the ratio the former bore to the latter in any mixture of the two. Thus, for example, in a mixture containing 30 per cent. of cane sugar and 70 per cent. of invert sugar, the influence of the former on the estimation of the latter was practically negligible, whilst in a mixture containing equal weights of the two sugars, the invert would be over-estimated by about 1 per cent., and in a mixture containing 99 per cent. of cane sugar and 1 per cent. of invert sugar, the latter might be over-estimated by something like 20 per cent. Thus instead of 1 per cent. of invert, 1·2 per cent. might be returned.

Simple Method for Indicating the Alkalinity of Carbonatation. *J. Bohle. Bull. Assoc. Chim., 1908, 25, 789.*

By the ordinary method of determining the degree of alkalinity during the carbonatation process, a little of the juice is filtered and titrated with standard acid, phenol-phthalein being used as an indicator. The author describes a simple method for indicating whether the juice has obtained the desired degree of alkalinity, which, it is stated, gives very satisfactory results in practice. He uses test-papers prepared by impregnating filter-paper with phenol-phthalein and citric acid, in such amount that juices which are too alkaline redden the paper, this coloration disappearing as soon as the proper alkalinity is reached. For a first carbonatation having an alkalinity of 0·07, the quantities recommended are, 3·5 grms. of citric acid and 1·5 grm. of phenol-phthalein; for a second carbonatation of 0·005-0·008, 0·25 grm. citric acid and 1·5 grm. phenol-phthalein should be used. The quantities given should be dissolved in about 500 cc. of alcohol and made up to one litre with water. The paper is cut into strips, saturated with the solution, then dried; it should then be tested against a solution having an alkalinity of 0·07 or 0·005-0·008, as the case may be, and if not correct the solutions must be diluted or concentrated until the indication is exact. These test-papers should be preserved in stoppered bottles and tested from time to time.

DECOLORIZING POWER OF SODIUM HYDROSULPHITE ON CARAMEL. *A. Herzfeld. Zeit. Ver. Deut. Zuckerind., 1907, 1088-1097.*

The decolorizing action of sodium hydrosulphite ("Blankit") on caramel and the intermediate substances which are formed by the heating of cane sugar, is studied. The caramel was prepared by heating cane sugar, for $1\frac{1}{2}$ hours, at a temperature of 180-190° C., and eliminating the undecomposed sugar by fermentation. The remaining unfermentable substance was found to be readily soluble in water, slightly soluble in absolute alcohol, more readily soluble in dilute alcohol, easily soluble in 95 per cent. methyl alcohol, insoluble in ether, ligroin, chloroform and in amyl alcohol. Phenyl hydrazine gave a flocculent precipitate; baryta-water produced a turbidity after standing for some time; alumina cream and ammoniacal lead acetate precipitated it completely from solution. Commercial caramels are stated to show the same properties. The behaviour of caramel towards ethyl and methyl alcohol serves, in some degree, as a means of separating the coloured substances composing it. The portions dissolved out by 95 per cent. methyl and 96 per cent. ethyl alcohol are light yellow to yellowish red in colour; the insoluble portion is dark brown and almost black.

The coloured bodies constituting caramel are capable of being decolorized by sodium hydrosulphite in a more or less degree, in acid as well as in alkaline solution. On heating solutions thus decolorized, a darkening takes place, the solutions which were originally darkest colouring to the greatest extent. Examining the action of new animal charcoal on caramel, the authors found that the caramel was completely absorbed by the charcoal; the absorption, however, took place very slowly and required a considerable amount of charcoal. Solutions treated previously with hydrosulphite, decolorized with a less amount of char, and much more readily, than solutions not thus heated; the decolorizing effect thus acquired remained permanent, even during evaporation. Comparative experiments were carried out using sulphurous acid against hydrosulphite; it was found that the decolorizing power of the former is considerably less than that of the latter.

BARFOED'S SOLUTION AS A MEANS OF DISTINGUISHING GLUCOSE FROM MALTOSE, LACTOSE AND SUCROSE. *F. C. Hinkel and H. C. Sherman. Jl. Amer. Chem. Soc., 1907, 29, 1744-1747.*

Barfoed's solution is prepared by dissolving 45 grms. of neutral cupric acetate in 900 cc. water, adding 1·2 cc. of 50 per cent. acetic acid to the solution after filtering, and making up to 1 litre. Five cc. of the reagent are placed in a test-tube, the solution to be tested added, and the mixture heated in a water-bath for $3\frac{1}{2}$ minutes. The contents of the tube are then examined for precipitated cuprous oxide; should no reduction be detected the tube is allowed to stand

at the temperature of the room for 5-10 minutes, the mixture then being again examined. If the amount of sugar present be too large, or heating too long, reduction due to disaccharide may occur. In a 1 per cent. solution of maltose, lactose, or sucrose, 0·02 per cent. of glucose can readily be detected. In order to examine the filtrate for maltose or lactose and to completely eliminate the glucose, 5 cc. of the reagent should be used for each 2 mgrm. of glucose present.

Blueing of White Sugars. *Stiegelmann. Chem. Zeit., 1908, 32, rep. 148.*

Indanthrene, it is stated, has given very favourable results when used for the purpose of blueing white sugars. It does not give off sulphuretted hydrogen, being perfectly stable; it is readily obtained and is without any injurious action.

Determination of Free Sulphuric Acid in Superphosphates. *A. Pomaski. Gazeta Cukrownicza, 1907, No. 12, through Bull. Assoc. Chim., 1908, 25, 785.*

The determination of the amount of free sulphuric acid in superphosphates is of importance; its presence is one of the indirect causes of the reverting of the soluble phosphates into the insoluble condition, and when present in large quantity it may exert an injurious action on the plant.

This method for its estimation is based on the insolubility of the sulphates of iron, alumina, the alkalis and the alkaline earths in absolute alcohol, this solvent only taking into solution free sulphuric and phosphoric acids. 30-50 grms. of the finely divided sample are treated with 150 cc. of absolute alcohol, at the ordinary temperature, the mixture being shaken from time to time. After 15-20 minutes the liquid is filtered, a portion of the filtrate neutralized with sodium hydroxide, and the solution evaporated to dryness. The residue is taken up with water, hydrochloric acid added to the solution, and the sulphuric acid estimated as barium sulphate in the ordinary way.

Nitrification of certain Nitrogenous Manures. *S. de Grazia. Società Chemica di Roma, Ordinary Meeting, January 26th, 1908.*

Manuring with ammonium sulphate, calcium cyanamide, and dicyanamide on sandy, clayey, peaty, and calcareous soils, it was found that the rate of nitrification proceeded very slowly except with ammonium sulphate, which was completely decomposed in about two months, whereas in the cases of the other three, nitrification had scarcely commenced after a period of four months.

Standard Light for Estimating Colour. *Joseph W. Lovibond.* *Jl. Inst. Brewing, 1908, 14, 2-7.*

The author has investigated the question of the discrepancies in the colour reading of liquids by the Lovibond tintometer (see Baker and Hulton, *Jl. Inst. Brewing*, 1907, 13, 26-29). He is of opinion that variations in light is the cause, and that it is necessary to have a standard artificial light which would give reading accordance with those obtained by north daylight.

After experimenting with various lights, that of the standard candle sanctioned by the gas referees was chosen. Such a source of light is sufficiently luminous, is easily procurable, has a recognised standard value, is not subject to grave fluctuations, and when used under the proper conditions gives readings which accord with those obtained by north daylight.

Correspondence.

CUBA.

To the Editor of the "International Sugar Journal."

Sir,—The situation of Cuba to-day, with special reference to our sugar industry as gauged by those especially interested, viz., the planters and cane farmers of the country, is very different from the glowing accounts sent to Washington! Time will infallibly tell who is right and who is wrong. Ever since our Provisional Governor took office, he has not once stirred out of Havana with the exception of a hurried visit to Matanzas on the eve of his call to Washington.

During the past year there has been little or no rain, and the cane in consequence has suffered tremendously in its growth; the want of money with which to attend to the necessities of cultivating has also resulted in the abandonment of the cane fields to grass and weeds; this want of money which is likely to continue is due to want of confidence on the part of Capital as a direct consequence of the revolution of last year. The revolutionists have been rewarded with the horses and money stolen by them and those who resolutely stuck to work in spite of difficulties, those who respected law and order, are as usual the ones to suffer, for considerable losses were sustained and without the shadow of a chance to make up for them.

The wonderful dry season during last crop caused all the cane available to be ground, and none remained over as in former years for the next crop; the frequent burning of cane fields, done generally by the cutters in order to have less trouble and gain more money in a given time, also injured the capacity of the plant for future growth.

All these certain truths, taken together, confirm the probabilities calculated by those actually and daily in the fields that the minimum shortage of the present crop will be between 40 or 50% of last year's

yield, many of those entitled to know what they speak of putting this shortage at 60%.

The Government have initiated a perfect rage for spending the few millions remaining in the Treasury, and what between roads which are being badly constructed and at great cost, and a ridiculous and perfectly useless campaign of fumigating on the part of the sanitary authorities, Cuba bids fair to become bankrupt in addition to being the most expensive country in the world to live in to-day!

The hands needed by sugar estates to cut the cane are to-day idling their time and pocketing big unearned wages on these roads and in these ridiculous fumigations! Most estates, even after paying higher wages than they can afford, cannot get the cane they need for the proper working of their factories.

The shortage of cane has brought about ruinous competition amongst planters in the purchase of canes! Such prices as 7% of sugar on the weight of the cane having been paid by some estates, and I suppose the average yield of sugar in Cuba will not pass say 10% to 11%. Government authorities gravely publish their confidence in planters extracting this year one or two per cent. more sugar on the weight of the cane! And why, whilst they are about it, they stop short at 2% speaks volumes for their modesty and the intimate knowledge of the industry whereof they treat!

The sugar of Cuba is to-day absolutely at the mercy of the Sugar Refiners' Trust of the United States. The famous reciprocity treaty has culminated in delivering Cuba, tied hand and foot, over to the refiners, who buy when they please and fix their own price independent of London, and always several points below that parity.

Recently, $5,000,000 were generously loaned by the Cuban treasury free of all interest for six months to the Cuban bankers, with the object, as it was said, of helping planters and cane farmers to start their crop. About this time began the famous financial crisis in the United States. There are not wanting those who have failed to trace one cent of these $5,000,000 either to the hands of planters or cane farmers! Who can tell what road those $5,000,000 took? The Agrarian League formed by the planters and agriculturists to formulate legislation of value and urgently needed by the great industry of Cuba (and all this free of cost to the nation, for they particularly and highmindedly refused the suggested pay made by the Provisional Governor to them) might as well dissolve for all the attention paid to them by the Government.

I am afraid you may blame me, Sir, for being too lengthy, yet I have but barely touched on the principal points of the situation to-day, and not to weary you too much I will stop short here, wishing Cuba a better fate than that of slave of the Sugar Trust of the United States.

Yours truly,

CUBAN PLANTER.

PUBLICATIONS RECEIVED.

Handboek ten Dienste van de Sukerriet-Cultuur en de Rietsuiker Fabricage op Java (Handbook on the Practice in Sugar Cane Cultivation and Raw Sugar Manufacture in Java). Third Part: De Fabrikatie van Suiker uit Suikerriet op Java (The Manufacture of Sugar from the Sugar Cane in Java). By H. C. Prinsen Geerligs. Amsterdam: J. H. de Bussy (Rokin 60).

This is the largest volume by far that has yet issued from the pen of Mr. H. C. Prinsen Geerligs; it consists of some 450 quarto pages. It forms an extension and amplification of his older well-known work, of which the English version was issued by us under the title of "On Cane Sugar and the Process of its Manufacture in Java." But since the latter work was written, the advance in scientific knowledge and factory procedure has been very extensive; and Mr. Geerligs finds enough new matter for his readers to fill a book three times as large as the old one.

We do not, however, propose to review at any length this Dutch edition, as it is to be followed up by an English version, now under preparation by the author, which will be ready in about twelve months from now. This volume will be published by us, and detailed particulars will be given in due course.

Proceedings of the International Congress of Applied Chemistry, Rome, 1906. *Volume III., Section V.:* The Industry and Chemistry of Sugar.

The Commission who have had the task of publishing the very numerous papers read at the International Congress of Applied Chemistry, held at Rome in 1906, have just forwarded us a copy of Volume III., which includes the whole of the *Sugar Section*. The complete proceedings of the Congress comprise 6000 pages, divided into seven volumes, but Volume III. is the only one that will directly concern our readers. The papers are reproduced in the original languages in which they were written, so that we find English, French, German, and Italian papers intermingled. A number of copies have been put on sale at the office of Messrs. Loescher & Co., Rome, at a price of 60 lire (48s.) the set of seven volumes, but single copies of any one volume can also be procured at the price of 12 lire (9s. 6d.) each. We are not informed whether these prices include postage or not.

Catalogues.—"Sugar Refineries," a small brochure issued by Messrs. Blake, Barclay & Co., of Greenock, on the occasion of the celebration of the firm's jubilee. A number of illustrations are given of refineries erected by the firm in various parts of the world, and it is pointed out that the cost of a very large refinery, designed and erected by them in the East, with its wharves, go-downs, and railway communications, and having a capacity of 5000 tons per week, amounted to no less than £500,000.

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. Thompson, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; and 322, High Holborn, London.

ENGLISH.—Applications.

4289. W. E. Evans, Upper Cam, near Dursley, Gloucestershire. *Twisting machine (for sugar boiling or the like).* 26th February, 1908.

4515. L. Rivière, London. *Manufacture of molasses freed from potash and industrial applications of said products.* (Date applied for under Section 19 of the Act, 28th February, 1907, being date of application in France.) (Complete specification.) 28th February, 1908.

Abridgments.

11799. C. B. Duryea, Cardinal, Co. Grenville, Ontario, Canada. *Process of manufacturing maltose.* 21st May, 1907. This invention consists in carrying the modification of the starch granules to such a degree that conversion of its highly concentrated paste or solution will take place promptly on the introduction of a very small percentage of diastatic agent, then adding a small percentage of such agent, for instance malt or malt extract, and subsequently separating and refining.

11800. C. B. Duryea, Cardinal, Co. Grenville, Ontario, Canada. *Manufacture of glucose.* 21st May, 1907. This invention relates to an improved process for the manufacture of glucose with the object in view of simplifying the method of procedure, and reducing the cost of manufacture, and improving the product.

18767. Dr. M. E. T. Melcher, Uerdingen on Rhine, Germany. *Process for winning large well-formed threadless crystals, especially sugar candy crystals, from cold or hot saturated solutions.* 20th August, 1907. This invention relates to a process for winning large well-formed threadless crystals, especially sugar candy crystals, from hot or cold saturated solutions by periodical motion of the mother crystals in the nourishing liquor during crystallization, by the employment of a system of horizontal sieves placed one above the other arranged in a jacketed crystallizing vessel, which sieves are covered with the mother crystals and are moved upwards and downwards in the nourishing liquid in such a way that the crystals remain floating for some time in the solution.

18774. F. M. Peters, Chicago, U.S.A. *Improvements in sugar-wafer machines.* 20th August, 1907. This invention relates to machines for producing sugar-wafers and analogous products, the principal object being to provide simple efficient and reliable apparatus for applying the filling material or paste to the wafer sheets and then spreading the same thereon.

26871. E. T. Newton-Clare, London. *Improvements in and apparatus for the manufacture of sugar.* 26th November, 1907. This invention relates to an improved manufacture of sugar direct from the juice of the sugar cane in which the heated saccharine solutions are submitted to a continuous evaporating and concentrating process and to a continuous stirring, mixing and drying process in a vacuum.

GERMAN.—Abridgments.

192192. Hans Mathis, of Ottleben, District of Oschersleben. *An apparatus for crystallizing a strongly supersaturated sugar solution by means of high pressure steam, compressed air, or the like, by which the sugar solution is violently agitated.* 5th February, 1908. The characteristic feature of this apparatus is a distributing chamber extending over the entire length of the crystallizing vessel, which chamber is provided with a slotted outlet aperture for the steam, air, or the like, which aperture lies at, or approximately at the lowest point of the vessel and extends also over its entire length, and is arranged at the sides of the chamber. Several connecting nozzles are provided between the distributing chamber and the feed pipe, and operate a uniform feed of the chamber along its entire length. The outlet aperture from the chamber is arranged on that side of the distributing chamber, towards which a circulation of the charge takes place, such circulation being caused by an agitating apparatus or means having a like action.

193235. Hugo Eichel, of Sangerhausen. *A wedge press for beet-root shreddings and the like.* 7th September, 1906. In this apparatus two or more such presses, which are of the ordinary construction, are arranged in tiers one above the other and combined to form a compound press, in such a way that the press chambers of the upper tier are continued into those of the lower tier, in order whilst more uniformly distributing the action to obtain a longer duration of the pressure and a greater straining surface.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of February, 1907 and 1908.

IMPORTS.

Raw Sugars.	Quantities. 1907. Cwts.	Quantities. 1908. Cwts.	Values. 1907. £	Values. 1908. £
Germany	1,611,822	1,255,008	724,298	618,045
Holland	41,521	55,011	16,604	26,080
Belgium	83,597	15,699	34,798	7,541
France	9,617	25,193	4,750	13,990
Austria-Hungary	182,816	167,790	81,790	84,864
Java	32	33,245	13	16,285
Philippine Islands	....	....	....	....
Cuba	....	....	..	....
Peru	74,236	188,123	33,187	95,509
Brazil	177,945	1,612	73,369	728
Argentine Republic	....	....	....	....
Mauritius	92,285	113,107	37,632	51,116
British East Indies	....	20,491	.	8,368
Straits Settlements	31,045	30,785	13,398	13,632
Br. W. Indies, Guiana, &c.	216,534	150,252	125,514	99,172
Other Countries	60,869	40,709	30,017	21,398
Total Raw Sugars	2,582,319	2,097,025	1,175,370	1,056,728
Refined Sugars.				
Germany	1,855,829	1,840,220	1,078,824	1,114,776
Holland	457,413	443,265	283,626	288,344
Belgium	41,692	38,868	25,910	23,693
France	196,853	142,049	113,670	87,681
Other Countries	85	8,646	45	5,309
Total Refined Sugars	2,551,872	2,473,048	1,502,075	1,519,803
Molasses	399,491	460,413	78,306	87,576
Total Imports	5,533,682	5,030,486	2,755,751	2,664,107

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	158	524	101	208
Norway	2,421	1,795	1,426	1,142
Denmark	18,254	14,930	9,506	8,163
Holland	13,076	10,930	8,475	7,529
Belgium	1,479	1,507	805	1,006
Portugal, Azores, &c.	6,272	1,320	3,483	769
Italy	4,659	1,858	2,449	1,075
Other Countries	43,223	30,510	31,571	23,175
	89,542	63,374	57,816	43,067
Foreign & Colonial Sugars				
Refined and Candy	1,520	1,840	1,167	1,474
Unrefined	6,437	9,777	3,493	5,975
Molasses	23	203	8	58
Total Exports	97,522	75,194	62,484	50,574

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1908. Tons.		1907. Tons.
Total Receipts Jan. 1st to March 19th..	425,929	..	488,788
Receipts of Refined ,, ,, ...	397	..	305
Deliveries ,, ,, ...	431,157	..	470,815
Importers' Stocks, March 18th..	392	..	17,973
Total Stocks, March 25th	210,000	..	257,630
Stocks in Cuba, ,, ...	211,000	..	371,000
	1907.		1906.
Total Consumption for twelve months..	2,993,979	..	2,864,013

CUBA.

Statement of Exports and Stocks of Sugar, 1907 and 1908.

(Tons of 2,240lbs.)	1907. Tons.		1908. Tons.
Exports	365,436	..	241,604
Stocks	285,090	..	165,532
	650,526	..	407,136
Local Consumption (2 months)	8,230	..	9,870
	658,756	..	417,006
Stock on 1st January (old crop)	....	..	9,318
Receipts at Ports up to February 29th.. ..	658,756	..	407,688

Havana, February 29th, 1908. J. Guma.—F. Mejer.

UNITED KINGDOM.

Statement of Imports, Exports, and Consumption for Two Months, ending February 29th, 1908.

Sugar.	Imports. 1906. Tons.		Imports. 1907. Tons.		Imports. 1908. Tons.	Exports (Foreign). 1906. Tons.		Exports (Foreign). 1907. Tons.		Exports (Foreign). 1908. Tons.
Refined	124,980	..	127,594	..	123,652	109	..	76	..	92
Raw	131,621	..	129,116	..	104,851	1,194	..	322	..	489
Molasses	17,856	..	19,974	..	23,021	138	..	1	..	10
Total	274,457	..	276,684	..	251,524	1,441	..	399	..	591

	Home Consumption. 1906. Tons.		1907. Tons.		1908. Tons.
Refined..	120,224	..	126,623	..	124,170
Refined (in Bond) in the United Kingdom	91,213	..	82,394	..	84,524
Raw	20,317	..	14,499	..	18,867
Molasses	17,834	..	20,605	..	19,206
Molasses, manufactured (in Bond) in U.K.	10,930	..	12,783	..	13,733
Total	260,518	..	256,904	..	260,500
Less Exports of British Refined....................	7,017	..	4,477	..	3,169
Total Home Consumption of Sugar	253,501	..	252,427	..	257,331

Stocks of Sugar in Europe at uneven dates, March 1st to 21st, compared with previous Years.

In thousands of tons, to the nearest thousand.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	Total 1908.
155	1231	565	883	212	3046

	1907.		1906.		1905.		1904.
Totals	3135	..	3469	..	2371	..	3202

Twelve Months' Consumption of Sugar in Europe for Three Years, ending February 29th, in thousands of tons.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria-Hungary	Holland, Belgium, &c.	Total 1907-08.	Total 1906-07.	Total 1905-06.
1882	1173	658	541	201	4155	4443	3864

Estimated Crop of Beetroot Sugar on the Continent of Europe for the current Campaign, compared with the actual crop of the three previous Campaigns.

(From Licht's Monthly Circular.)

	1907-1908.	1906-1907.	1905-1906.	1904-1905.
	Tons.	Tons.	Tons.	Tons.
Germany	2,132,000	2,239,179	2,418,156	1,598,164
Austria	1,430,000	1,343,940	1,509,789	889,431
France	725,000	756,094	1,089,684	622,422
Russia	1,410,000	1,440,130	968,500	953,626
Belgium	235,000	282,804	328,770	176,466
Holland	175,000	181,417	207,189	136,551
Other Countries .	435,000	467,244	410,255	332,098
	6,542,000	6,710,808	6,932,343	4,708,758

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NOTES AND COMMENTS.

The Outlook at Home.

The past month has been a momentous one at home. The long-continued illness of the Prime Minister, Sir Henry Campbell-Bannerman, finally necessitated his withdrawal from office. He was not, however, to enjoy the solace of retirement many days, for a week later the country had to mourn his death. His mantle has fallen on Mr. Asquith, and an extensive reconstruction of the Ministry has followed. The new Premier's right hand man, Mr. Lloyd George, has moved from the Board of Trade, where he proved a most useful administrator, to the Exchequer. Lord Elgin has retired from the Colonial Office, and his second-in-command, Mr. Winston Churchill, has been promoted to the Board of Trade. If one is to judge from reports cabled home from the colonies, Mr. Churchill's departure from the Colonial Office has been a matter for much congratulation. But still more gratifying has been the severe check this rising politician has received at the polls. His promotion to the Cabinet necessitated his offering himself to his constituents for re-election. After one of the fiercest fights ever chronicled in the annals of bye-elections, Mr. Churchill lost his seat, and the Government of which he is now a member received a severe rebuff, which coming on top of previous

reverses must tend to make Mr. Asquith's progress a matter of uncertainty and great difficulty. How the new President of the Board of Trade will comport himself, especially as regards sugar and the Brussels Convention, remains to be seen; but if some of the statements he is reported to have made during his electoral campaign on these subjects are to be taken as a criterion of his attitude, we are threatened with the prospect of still more biassed administration than was the case under his predecessor, Mr. Lloyd George. Fortunately, however, no very momentous questions are likely to come up for settlement within the near future, as the one subject that most concerns us, the continuation of the Brussels Convention, has been agreed to internationally, and is not likely to be tampered with by a Government which has its hands filled with highly contentious home legislation. Elsewhere we comment at some length on the outlook for the sugar industry in the near future, especially having regard to the nature of Russia's and Italy's participation in the Convention. We trust that the view we have taken will not prove unduly optimistic.

A Parasite for the Sphenophorus obscurus.

We learn the interesting fact that Mr. Muir, of the staff of the Hawaiian Sugar Planters' Association, has succeeded after nearly two years' search in discovering a parasite of the *Sphenophorus obscurus*. He visited Southern China, the Malay States, Java, Borneo, and finally found what he was in search of in the island of Larat. An entomologist has gone from Honolulu to Hong Kong to establish a half-way station to receive parasites forwarded from Larat, breed them a second generation, and then transmit them to Hawaii. As will be known to many of our readers, the *S. obscurus* is closely related to the *S. sericeus* of the West Indies, and is the "Weevil Borer." It is not yet known, of course, whether the new parasite will prove successful, but the best is anticipated from it, and we shall look forward with interest to the results of its trial.

Honolulu Mills for Formosa.

The manager of the Honolulu Ironworks writes to us to correct the statement made on p. 517 (October, 1907) of this Journal, on the authority of the British Consul at Tainan, that a new 2000 ton mill to be erected at Ako by his Company was purchased second-hand at Honolulu, and was to be erected after having been renovated with improved machinery. Our correspondent states that, as a matter of fact, everything in the equipment of this factory (or rather factories, for it really comprised two of 1000 and 1200 tons respectively) is of the most modern description, and no second-hand or old machinery whatever was incorporated in the plant.

THE NEW SUGAR CONVENTION AND AFTER.

The permanent Commission at Brussels held a brief sitting on the 27th March, at which it was decided to give Italy the exceptional benefit of a delay of three months in order to enable the Italian Government to have further time for the consideration of their special position. So long as Italy does not export it is permitted to retain a fiscal system which is regarded, by the terms of the Convention, as involving a bounty. The high surtax enables the Italian sugar producers to obtain an abnormally high price for their sugar in the home market. This stimulates production, and the time approaches when Italy will be compelled to export. The Italian Government will then be compelled either to abolish their bounty system or to retire from the Convention. If the Convention had not been tampered with by our, so-called, Free Trade Government the situation would have been very simple. The bounty-fed sugar from Italy would have been prevented from destroying Free Trade in sugar in British markets, and Italy would have been compelled to bring its surtax down to the limits prescribed by the Convention. But now that the Convention has lost its mainspring it has become impotent, and Italy is considering what policy to pursue. The Italian Government might fairly argue that as Russia has been permitted to retain its high surtax and yet become a member of the International Convention, provided that it limits its exports to 200,000 tons per annum, *plus* its usual exports to Finland and the East, there can be no reason why Italy—or any other country—should not enjoy a similar privilege. The Commission seems to have taken a different view and has given Italy three months grace to think the matter over.

In the mean time the makers of condensed milk in Italy complain that Russia will presently be supplying their British competitors with sugar "at a price lower than that paid by other countries." This, of course, is a popular fallacy. The sale of Russian sugar in large quantities may force down prices, but the fall in price will be the same for every one. It is quite possible that the Italian makers of condensed milk, having to buy their sugar in a heavily protected country, may not benefit much by the fall in the world's price of sugar; but that is no reason why they should blame the Sugar Convention. Their complaint is really against the British Government for permitting bounty-fed sugar injuriously to compete with sugar which receives no bounty. If the Convention had not been mutilated they would have had no cause for complaint. Their only remedy now is that Italy should become an exporting country and should, therefore, be compelled, under the terms of the Convention, to reduce her surtax to 6 fr. per 100 k. But how Italy can be compelled to conform to the letter of the law when Russia has just been allowed to evade it is difficult to comprehend.

The figures of Russian production, consumption and exportation, just published, are highly interesting and instructive. The area cultivated, and from which a crop was actually reaped, was, in 1898-9, 401,000 déciatines. In 1902-3 this area had risen to 525,000 déciatines. It fell, in 1904-5, to 430,000 déciatines, and rose, in 1906-7, to 520,000, and in 1907-8 to 556,000 déciatines. These figures indicate that the Russian bounty—the high surtax—has been a powerful stimulant to increased cultivation of the sugar beet, and that it is only when a great plethora of unsold surplus stock weighs upon the market that there has been any disposition to check the increase. The stock of sugar at the beginning of the crop, 1898-9, was only about 116,000 tons, and remained at about that figure till 1901-2. Increased sowings during the following years raised this initial stock to 230,000 tons in 1902-3, 340,000 tons in 1903-4, and 430,000 tons in 1904-5. This brought about reduced sowings, and the stock fell to 230,000 tons in 1905-6 and 160,000 tons in 1906-7. Increased sowings brought the stock up to 460,000 tons on 31st August, 1907, and probably to 650,000 tons on the 31st of next August. Under ordinary circumstances this would again be followed by reduced sowings. But under present circumstances—a short crop in Cuba and some other cane sugar countries, and a consequent rise in prices—coupled with the fact that Russia is now permitted to export 200,000 tons a year in addition to her normal exports, it is possible that large sowings may be maintained for another year. But although prices have risen, owing to pressing wants in the United States to make up for short supplies from Cuba, the quotations for new crop beetroot are at a discount of 1s. 3d. per cwt. This indicates the fear of large exports from Russia, and no doubt the fear is well founded. It is most fortunate for holders in Russia that they will have a good market for their big surplus stock, even if they do have to accept less than the present market rate. The British Confectioners will have plenty of white sugar, and the British Government will no doubt take all the credit to themselves. Whether the British refiners, our Colonial sugar producers and our allies under the Sugar Convention will be equally pleased is somewhat doubtful. If we have a good beetroot crop and good cane crops it is quite possible that the Russian surplus may next year turn the scale and bring us down to normal prices again. In 1896 the Russian surplus smashed what looked like a very strong market, and it might do so again.

The constant large increase in the Russian consumption of sugar is very remarkable and must be attributed to the steady expansion of the boundaries of that vast country. The price of sugar in Russia is artificially raised to a very high figure owing to the enormous surtax on imports. There cannot, therefore, be much ground for supposing that the consumption per head of the population is increasing to any great extent. The increase, from 1900-1 to 1905-6, was more than

40,000 tons per annum. In the first year the consumption was 740,000 tons, and in the last 990,000 tons.

The average yearly exports for the six years ending 1906-7 were 170,000 tons. The lowest figure was in 1905-6, when only 63,000 tons were exported. The bulk of these exports went to Finland, Persia, and Turkey. The exports to Western Europe were small. It may therefore be said that, in round numbers, Russia will in future be permitted to export 200,000 tons a year in addition to about 130,000 to 150.000 tons to Finland, Persia, and Turkey.

With this prospect in view we must beware lest any further tampering with the Convention be attempted. Theoretically, the security for freedom of competition which it gave us has been withdrawn. For the first time for more than forty years we enjoyed Free Trade in sugar when that Convention came into force. The sugar industries of this country and our colonies began to breathe again, new sugar machinery was turned out in large quantities by our great engineering firms and everything looked hopeful. But the party who are supposed to be, in Mr. Asquith's words, "the bulwarks of Free Trade" came into power and promptly restored "protection to foreign producers in British markets." All this is the result of "arm chair professors" dictating to the people of this country what are the true principles of political economy. Without any practical knowledge of industry, of markets, of the many causes which produce the final results of international competition, they calmly pronounce from the quiet recesses of their studies the edict that Free Trade means "duty for revenue purposes only," and that any departure from that rule is a terrible economic sin. They are quite unconscious of the fact that freedom of industrial competition is being destroyed by our blind adherence to this erroneous and most mischievous fallacy.

Even when foreign goods are being sold below cost price they will not budge from their pernicious dogma. They hail the sale of goods below cost price as a blessing to the consumer. Their political economy does not even teach them the rudimentary fact that such a competition must inevitably lead to the injury and eventually to the ruin of whatever industry may be thus attacked. This means higher prices to the consumer and his greater dependence on a foreign monopoly. This they call a blessing to the consumer.

These general remarks on the lamentable ignorance of our so-called Free Trade professors, though made in reference to the absurd policy of our present Government with regard to the Sugar Convention, do not ignore the fact that the mutilated Convention still exists and that, so long as bounties in the great producing countries remain abolished we may, in the long run, try to ignore those smaller bounties which remain. Russia may create from time to time a small artificial

disturbance in the natural course of trade; but our big trouble is still removed and we can, therefore, continue to look forward to a future when sugar will be produced freely under natural conditions, giving work to our engineering and other industries in new countries, and restoring our older sugar producing colonies to prosperity and progress.

THE TECHNICAL MANUFACTURE OF CHEMICALLY PURE LEVULOSE.

By SIGMUND STEIN, Sugar Expert, Liverpool.

(Read at the 2nd International Congress of the Sugar Industry, Paris, 7th April, 1908.)

Levulose (fructose or fruit sugar) is made at present either according to the old Dubrunfaut method or according to the new Schering process, out of invert sugar or molasses.

The present processes are however too expensive, so that levulose commands to-day the price of 5s. per lb. It is, therefore, not at present popular, being very little known and very little used, and is exclusively sold by pharmaceutical chemists.

It is also very difficult, according to the known Dubrunfaut method, to manufacture chemically pure levulose, as the separation of dextrose from the levulose by lime out of an invert sugar solution does not take place quantitatively.

I have myself made many experiments with the Dubrunfaut method, but could not obtain chemically pure levulose. The only process to make such levulose on a large scale is that from Inulin.

INULIN.

Inulin is found in dahlia bulbs (10-12%), in the chicory root (Cichorium intybus) (6-11%), and in the *Jerusalem Artichoke* (Helianthus tuberosus). Inulin forms a white, starchy, tasteless powder of a sphero-crystalline nature. It is soluble in warm water, but practically insoluble in alcohol. Alcohol of 95% dissolves at 16°C. 0·24% Inulin. It is also hygroscopic; a hot saturated solution of Inulin on being cooled, yields only one part of Inulin, as a sediment; another part precipitates afterward. Inulin melts at 160°C.; its specific gravity is 1·465.

It is levo-rotatory; and is not blued with iodine. It does not reduce Fehling's solution, but an ammonia-silver solution is reduced. With hydrate of baryium it gives a precipitate, which however is not decomposed by CO_2. Inulin is not precipitated by acetate of lead, nor by salts of Cu, Hg, Fe, Ag, and Au. The aqueous solution does not form a paste like starch. If burnt, it gives a smell like caramel. It is not fermentable. With diluted acids or with water under pressure

it gives levulose. Inulin is soluble in a cold solution of potassium hydrate, out of which it is precipitated with acids.

The quantitative determination of Inulin is accomplished by its inversion to levulose and the determination of levulose with Fehling's solution.

The technical manufacture of chemically pure levulose therefore consists of:—

(1.) The manufacture of Inulin.

(2.) The inversion of the Inulin to levulose with diluted acids.

As above mentioned, Inulin is found in many plants, but for commercial manufacture the dahlia bulbs and the chicory root only will be considered.

(1.) Dahlia bulbs.

These first came to England from America in 1789, and in 1812 to Germany. The first attempts made were to cultivate the dahlia like potatoes and use them as cattle food, but this experiment failed, as the cattle would not eat them. At present the dahlia is cultivated all over Europe for horticultural purposes. In London and other English towns an exhibition of dahlias is an annual event. For the technical manufacture only the bulbs of the dahlia are used. Their size varies, and one is able by proper propagation to produce bulbs weighing 500 to 700 grammes. As one of the principal dahlia cultivators of England informs me, one can produce dahlia bulbs to the size of a man's head. Dahlia cultivation is very simple, and once cultivated on a large scale and industrially used, they can be produced like potatoes. At present grown only as an ornamental plant, the dahlia is valued at the price of such a plant, but once cultivated in many thousands of tons, and industrially used, the dahlia would form a cheap raw material, and would not be more costly than potatoes.

I have had interviews with the largest English dahlia cultivators, and they are prepared to contract for a large area of this plant. Naturally at first the dahlia could not be produced very cheaply, but the price will fall from year to year with the extent and the expansion of the cultivation. The dahlia thrives in all climates, and any acclimatization in Europe is no longer necessary, as it has been naturalized over 100 years.

(2.) The chicory root.

This plant is well known, being cultivated to the extent of many hundred thousands tons in Germany, Austria, France, Belgium, etc., for the manufacture of the well known coffee substitute.

Regarding its application to the manufacture of levulose, it must be noted that, as a temporary expedient, chicory is an already existing raw material, whereas the cultivation of the dahlia has yet to be introduced. In England, the cultivation of chicory was common enough 40 years ago (especially in Yorkshire), but of late it has

greatly decreased, and two years ago the British Board of Agriculture made enquiries with a view to seeing whether it were possible to extend its cultivation.

I have analysed chicory roots grown in England, Germany, France and Belgium. The average content of Inulin was 9·8% (varying from 7·5% to 11·3%).

The dahlia bulbs contained according to my analyses an average content of Inulin of 12·1% (varying from 9·2 to 13·4%).

Technical Manufacture of Inulin and Levulose.

The raw material (dahlia bulbs or chicory root) is first cut, then steamed with the addition of milk of lime, pressed in hydraulic presses, and the juice clarified. The latter is next poured into a revolving cooler, where it is frozen into flakes. The flakes are transferred to a tossing apparatus and tossed up, after which the juice is centrifugalled in the Inulin centrifugal machine. The Inulin so produced is washed and cleaned. The cleansed Inulin is then dissolved in hot water, treated with diluted acids, and converted thus into levulose. The levulose solution is evaporated and boiled in a vacuum pan to the consistency of syrup.

Considering the simplicity of the method of manufacture, and the ease of its execution, one can see that levulose could be manufactured cheaply. According to my calculation, it could be manufactured and sold at a profit of 6d. per lb. At such a price it would find a large application, and a new and lucrative industry would be created.

As with the saccharose in sugar beet, one could by rational cultivation improve and increase the percentage of Inulin in the dahlia and chicory roots. The sugar beet 100 years ago contained only 7% of saccharose, while to-day one can find roots with a contents of 21% sugar. The larger the proportion of Inulin in the raw material, the cheaper the levulose can be manufactured.

The Use of Levulose.

Levulose can be used in any case where saccharose is used, but besides this, levulose can be used owing to its qualities as follows:—

1. For medical purposes.

(*a*.) As food for diabetics.

Diabetes involves an incapacity for using carbohydrates as nourishment. More or less of the sugar which is passed with the food into the body, be it saccharose or lactose or dextrose, passes through the body and acts as a poison. Levulose is recognised by the highest medical authorities as the only sugar which most of the diabetics can partake of, and which can be entirely assimilated by the organisms. Saccharine, which is used by the diabetics at present, is harmful to such patients, according to the investigations of Prof. Stoklasa and Prof. Neumann.

(*b.*) As a preventative against hyper-acidity of the gastric juice.

Unlike saccharose, levulose has the power of neutralizing the acids of the gastric juices.

(*c.*) As food for consumptives.

Within the last few years, a number of well known medical authorities has recommended the use of large quantities of levulose as a remedy against consumption in the first and second degree. According to these authorities levulose acts in this disease like a specific, and cures have taken place in many cases, through the daily use of several ounces of levulose mixed with the food.

Without doubt the use of levulose for this special medical purpose will be better known when levulose is manufactured and sold at about the same price as ordinary sugar. Consumption and tuberculosis are spread, as is well known, amongst a seventh part of the population of most countries of Europe. Levulose once manufactured cheaply will be the sugar which the consumptives could exclusively use.

(*d.*) As food for infants.

Many medical authorities have lately recommended levulose for infants, as levulose has not the aperient effect of lactose. Medical authorities have further stated that levulose is an excellent substance for the nourishment of infants which suffer from wasting illnesses. Levulose has increased the weight of such children 300 to 400 grammes per week. Professor Fuerst stated that levulose deserves the preference over milk sugar for the nourishment of infants, because the former is sweeter and has not an aperient effect.

2. In industries.

(*a.*) In the confectionery industry, to prevent the crystallizing out of saccharose, and to prevent the clouding of the clear products.

(*b.*) In the brewing industry, where it can replace advantageously glucose and invert sugar.

(*c.*) In the manufacture of marmalade, jellies and preserved fruits, where the levulose prevents the crystallization of the saccharose and the cloudiness and solidifying of the goods.

(*d.*) In the manufacture of artificial honey, as the levulose forms the principal part of the natural honey, and because artificial honey manufactured from levulose remains clear and does not solidify.

(*e.*) In the manufacture of champagne and in the improvement of wine, because levulose has here many advantages over saccharose.

(*f.*) In the manufacture of artificial ærated waters, because levulose gives them an agreeable taste.

The project started as far back as 1906 to reduce the excise duty on sugar in Holland and increase the duty on spirits has now been abandoned, the Bills providing for these changes having been withdrawn.

PERU.

The Manufacture of Sugar.

We give in the following pages a further translation from the Bulletin of the Lima Sugar Experiment Station, dealing with the manufacturing side of the industry.

The factories are buildings expressly constructed for the object in view and are usually two-storied. Some of the modern ones are merely modifications of old buildings enlarged and adapted to fit them for the new purpose for which they are intended. The installations of machinery are naturally not of the same manufacture, amongst the various makes being found those of Fawcett Preston, McNeil, McOnie, Fives-Lille, besides apparatus manufactured in the country. The factories are in general lighted by electricity, but some use kerosene, and one acetylene.

Furnaces and Boilers.

Some establishments employ furnaces which burn dry bagasse, others use furnaces which burn the trash in a green state, and there is observable a marked tendency to change the old furnaces for those burning the green bagasse. In the majority of furnaces, sufficient air enters for normal working, but in some ventilators are employed to aid combustion.

In some haciendas, as the furnaces have been built on damp soil, it has been necessary to drain off water by means of pumps.

Boilers are of various kinds, some being of the Lancashire type with one or two flues, others tubular and multitubular, especially Babcock & Wilcox. The number of boilers varies. There is a decided tendency towards the replacement of boilers of the old type by those of the Babcock & Wilcox pattern and there is considerable progress in this branch of the manufacture.

Fuel is a felt want in many haciendas and then the use of trash becomes necessary. More steam is needed in some establishments, and on the other hand there is too much in some others. In the majority of factories, water condensed from the escaping steam is utilized in feeding the boilers. The proper utilization of the steam is a point which must be carefully studied, as it affords an opening for effecting economies.

Extraction of the Juice.

Pressure.

Triple pressure, but with independent engines, is resorted to by some establishments, but the majority of the big houses use double crushing, and a few moreover employ imbibition. Many haciendas have only one mill, and in one instance there is a defibrator with

double pressure as well. Some of the firms contemplate the introduction into their works of triple pressure with only one engine. Where double pressure is practised, the two mills are driven by separate engines, except in one case.

We have in some instances found mills with five rollers. The pressure is sometimes hydraulic; and in a few establishments the mills are driven by hydraulic power. The rollers vary in size from 32 inches by 66 inches to 44 inches by 78 inches, and there are a few small ones in which the proportion is 24 inches to 48 inches.

Extraction in most cases is estimated by the percentage of the weight of the extracted juice to the weight of the cane, but there is one hacienda which employs another method as well, viz., the percentage of extracted sucrose to the sucrose of the cane, as is customary in Java and Hawaii. The percentage of extraction from the cane with double pressure varies generally between 63 and 68 and depends on the class of cane. Sucrose extracted per cent. from the sucrose of the cane varies between 78 and 84 with the same system of pressure.

Some large mills can grind 30 or 35 tons of cane per hour, but there are many which only grind eight tons and sometimes less than that. The speed of the mills varies very much. Probably in some haciendas they grind in excess of the capacity of the mills and even beyond what their machinery and tanks can utilize.

In many houses carriers raise the cane trash to a height whence it falls into carts drawn by men or animals. It is then taken out to the canefield to be dried, in which operation from 20 to 30 men are employed. In other places, the trash falls into Decauville cars which take it to the mouths of the furnaces where it is burnt in the green state. In yet other houses the bagasse is brought direct to the mouths of the furnaces by carriers, and in this case the furnaces are fed either by hand or by automatic stokers.

Defecation.

Defecation of the Juices.

Defecation is carried out by houses manufacturing sugar for export immediately the juice passes out from the mills. But when houses manufacture for home consumption, the juice first undergoes sulphitation.

The defecators are of the usual type in almost all establishments, and only vary in regard to their capacity. They are of copper, have a double bottom, and are driven by direct steam-power. In number they may be from 3 to 12, and have a capacity of from 500 to 3,000 litres. In some haciendas waste steam is utilized in heaters for heating juice undergoing defecation, but in other houses direct steam is exclusively used for this purpose.

In some factories defecation is effected by adding lime to the juice in a cold state until neutralization takes place, heating it afterwards in the defecators and drawing it off in from three-quarters of an hour to

an hour and a half. In other factories the juice is heated to about 80° and then limed, defecation following in from 20 to 30 minutes. In defecating, in general, lime is added till alkalinity takes place, some factories preferring to retain a little acidity, others going on to complete neutralization, using litmus paper as an indicator. The lime used in this operation is usually produced in the factory or in a place close at hand, though there are factories which have made the experiment of importing lime from abroad. In defecation, no other chemical is employed than lime.

The clear juice being drawn off, passes to the deposit tanks, the thick juice being collected separately to undergo a fresh defecation. In no factory have we observed defecation by the continuous or Deming system.

Clarification of the Juice.

In some factories there are appliances for boiling off. Some factories have tanks with horizontal steam pipes, others have horizontal pipes with a worm, whilst others again have tanks with an overflow.

The old juice-elevators are to be found in some factories, but the majority of them use pumps, mostly of the Worthington type. The construction of the factories does not allow of the juice being brought up in one pumping operation so that afterwards its weight could be utilized in manipulating it, hence the necessity of its ascent taking place in three or four stages in which separate pumps are employed.

Filtration.

Filtration of the clear juice after defecation takes place in some but not all factories. The filters are of sand, sometimes on the modern system, sometimes on the old, but in some cases cloth filters are used. These cloths are washed by hand or by machinery.

Most factories filter after defecation, but some filter at the stage when the syrup is being drawn off.

In some factories only filter-presses are used for scum and dregs, whilst in others all the juice is passed through these filters. The number of filters for the clear juice ranges from one to eight and more, and of filter-presses from one to eight.

The weight of the juice is ascertained indirectly from its density, and we observed no apparatus for weighing it directly. In most of the factories the Beaumé instrument is used, as against the Brix, but the former is being gradually less and less employed. The scums, in some establishments, are sent straight to the distillery with the residue of the filtered syrups, and in others the dregs go through the filter-presses until they are drained, and are then baked in the form of cakes. They contain about 10 per cent. of sugar, and in some factories are used as manure, in others as fodder, whilst other factories yet again utilize them as fuel.

Evaporation of the Juice.

The evaporation apparatus mostly employed is the triple-effect, but in some factories they use quadruples and in others double-pans, mostly of the vertical type, though some are horizontal. In only one factory do there exist two quadruple-effects.

Direct steam is used in some factories, but in the majority of them waste steam is invariably employed. Concentration is effected on the drawing off of the juice at 24 to 30 Beaumé. The vacuum in the pans varies, ranging from 4 inches in the first to 24 inches in the last.

Clarification of Syrups.

Syrups are clarified in some establishments by elimination. Some of them do not clarify at all but deposit the syrups in tanks, whence they pass to the vacuum pan. Scum is eliminated by hand with a skimmer, or by means of the overflow.

Boiling.

In most factories the vacuum pan is used. The vacuum usually varies between 24 and 28 inches. The vessels and vacuum pan have each as a rule a separate pump, but sometimes the vacuum is centralized.

For the boiling, direct steam and waste steam combined are used, but occasionally direct steam alone, in which case it is not employed to a large extent. In some establishments they have reached the point of using only waste steam. The capacity of the vacuum pans varies from 5 to 25 tons.

Concentration of the masses is effected at about 92 to 95 Brix. There are various ways of boiling, depending on the quality of the sugar to be produced and the market demand. Thus, some manufacture large grain, some small, some medium. Some manufacturers put the sugar direct into the vacuum pan to form the grain, others use only the first juices, and one establishment employs a Javanese system of crystallization in motion, thus obtaining one class only of sugar. The time required in boiling depends upon the class of sugar which is to be produced, and the vacuum pan used. Some factories possessing two vacuum pans begin the boiling in one and then divide it amongst the two until completed. In some factories they first make the grain in a small vacuum pan, and then transfer to a larger one to make large grain sugar.

Handling the Masse-cuites.

The masse-cuites on being drawn off from the vacuum pan are passed into receptacles called coolers, where they remain for from 24 to 48 hours. These receptacles are of various forms and varying capacity, some being movable and others large cooling tanks. There is, as a rule, a large number of them. In one factory there are no coolers of this kind, their place being taken by crystallizers-in-

movement. The coolers are unloaded in various ways, some by elevators which lift them with the masse-cuites to the centrifugals, others by small hand buckets, while other factories use chain elevating pumps. The masse-cuites are deposited in a chamber furnished with a small malaxeur in which they are treated, water being sometimes added to make them more fluid, particularly when automatic elevators are used. In some factories juices are used instead of water, in others water mixed with juice, and in others again no liquid is used.

Centrifugalling.

By some factories this operation is effected in suspended centrifugals; in others the machines are fixed, and power is transmitted downwards. Some are driven by steam, others by water turbines, and there are others again in which the motive power is electricity or derived from hydraulic power. The centrifugals vary in number from 4 to 10, run at from 800 to 1200 revolutions per minute, and are from 28 to 40 inches in diameter. The time employed in centrifugalling is from 5 to 15 minutes, and depends on the class of sugar and the type of centrifugal.

In the case of sugar for home consumption, water is used by some factories in centrifugalling, and in others water and steam, but this is not generally the case in regard to sugar for the export trade; though occasionally water or juices are employed for this branch of the trade also. Sugar is generally discharged from the centrifugals downwards, but sometimes from above, by hand. It is then carried off either by a conveyor, an endless screw, or in some cases by a car pushed by a man.

Drying.

In some factories the sugar passes direct from the centrifugal to the bags, in others it is spread out in storehouses to dry. Other factories, usually those manufacturing for home consumption, employ special means of drying.

We observed no machinery for drying the bags. Weighing is generally done with ordinary scales, but in some places there are automatic weighers, and we have also seen an automatic machine which filled and weighed the bags of sugar.

The bags are sometimes loaded by lifting them from the stores on to cars, and sometimes the rails come right up to the stores; in other factories there is a platform on a level with the car, by which matters are much facilitated. In other factories the storehouse stands higher than the car, into which the bags are run down an inclined plane, by which method the cars are very quickly loaded.

Classes of Sugar made.

In most of the factories granulated sugar is produced, and loaf sugar only in a few. In any one factory, as a rule, only one kind of sugar

is produced, but there are a few factories producing two, three, and even four kinds. Some factories produce sugar both for the home market and export, others for the home market only, and others again exclusively for export.

Transportation of Sugars.

Sugar produced for export is usually carried to the shipping port by rail, the main line either having a station at the factory or connecting with it by a branch line. In one or two cases, however, the sugar is transported by waggons to the nearest station of the line by which it is to be taken to the port of shipment. Arrived at the port, it is put on board the steamers by lighters. We did not observe any elevators for loading the steamers with sugar. Only one port in the country has a dock, which, in time, will enable perfected machinery to be employed in shipping the sugar.

MOLASSES: ITS DEFINITION AND FORMATION.

By H. C. Prinsen Geerligs.

On curing the last after-product masse-cuites, a syrupy liquid is drained off, which on further evaporation and cooling does not give off any more sugar crystals, and bears the name of "exhausted molasses." Although no sugar can be crystallized out, it always contains, in conjunction with the accumulated impurities originating from the clarified juice, a considerable amount of sucrose, which can no longer be separated by crystallization, and is therefore practically lost. This is due to the fact that in the molasses the sucrose no longer exists in a free state, but is combined with some constituents of the juice to form viscous, uncrystallizable bodies, which, on evaporation, may be changed into a dry mass, but even then do not give up their sucrose content. Unless we succeed during clarification in removing from the juice everything but sucrose and water, which is an impossibility, we are sure to find molasses at the end of every process of sugar extraction from the juice; and systems which claim to make sugar from juice without any molasses formation can, without any further investigation, be deemed unreliable.*

The real nature and the conditions of molasses formation have for a long time been a constant point of dispute between the different investigators, and even now the question is not yet definitely settled, although unanimity exists at last as regards the principal points.

Formerly it was the general opinion that sucrose could not crystallize any more from the molasses because of the non-saccharine

* The so-called "concrete sugar" is only an apparent exception to this rule, as it contains the whole of the dry substance of the juice, crystals, and molasses in one agglomerated mass, and is therefore not a pure crystallized sugar.

constituents making the liquid so viscous at the high concentration that the sucrose molecules were prevented by this great viscosity of the mother-liquor from combining into crystals, and thus were forced to remain in solution. At first sight this explanation appears very acceptable, but its probability decreases if we consider that sucrose crystallizes slowly yet perfectly from very stiff jellies, and a sucrose crystal can be made to grow regularly when suspended in a solution of sugar in isinglass.

Further, this theory is at variance with the fact that in an osmosed molasses, where the non-diffusing viscous colloids are accumulated, the sucrose crystallizes out again, whereas, according to the theory, its crystallization should have totally ceased.

The so-called "mechanical molasses theory" was soon abandoned, and the opinion was increasingly formed that the prevention of the crystallization of sucrose in molasses was due to chemical influences. A general idea prevailed that the sucrose combined itself with other constituents of the molasses to form very soluble bodies, so that the solubility of the sucrose as well as that of the accompanying constituent in that combination was much more increased than when both were present separately. According to Dubrunfaut, a solution of common salt can dissolve more sucrose than the water contained in the solution would have been able to do, if it did not contain the salt. On the other hand a saturated sucrose solution dissolves twice as much salt as the same amount of pure water contained in the solution would have done. The simple explanation of these phenomena can be given by assuming that sucrose and sodium chloride enter mutually into a very soluble combination, and if we bear this in mind we can very easily explain the whole formation of molasses; and it is to be regretted that this simple evolution of Dubrunfaut's experiment has not been made sooner, as it would have saved us much misunderstanding.

In beetroot molasses the solubility of the sucrose in the amount of water contained therein is larger than would be the case at the same temperature in the same amount of pure water, and as in former times beetroot molasses was the sole object of investigation everybody clung to the idea that in every molasses the solubility of the sucrose had always to be higher than normal, and all theories and observations were based on that principle. Whilst it was known that some salts increased (as was the popular saying) the solubility of sucrose, and therefore possessed a melassigenic power, a great number of chemical bodies were tested as to their property of increasing or decreasing the solubility of sucrose in water, and thus determining their melassigenic power. Still under the impression that the molasses-forming power was always identical with the increase in the solubility of sucrose, the different bodies were divided into positive, negative and indifferent molasses-formers,

according to the increase, decrease, or stability of the solubility of sucrose in aqueous solution in the presence of those bodies. This division is still in great favour in most treatises and publications on molasses and the denomination of *positive or negative molasses-formers* is still widely used. It was, however, observed that some bodies proved to be negative molasses-formers in dilute concentrations but positive ones in high concentrations, and finally the whole matter was left an intricate mass of misunderstanding and controversy.

The simplest solution is, however, to assume that all salts, both organic and inorganic, combine themselves with sucrose to hydrated bodies, each of them having its own solubility. If we consider first the case where the solution contains as much sucrose and salt as possible, we can observe two alternatives. Either the combination is very soluble in water, and then much of the salt and of the sucrose enters into solution, and we may call the salt a positive molasses-former; or the combination is only slightly soluble, the saturated solution therefore only contains relatively little salt and sucrose, and the salt thus belongs to the negative molasses-formers.

Köhler* showed that, in general, the solubility of sucrose in a solution of non-sugar and also the solubility of non-sugar in a sucrose solution are mutually in such a relation, that from either body as much is dissolved as it can dissolve of the other body, and that solutions containing sucrose and large quantities of non-sugar contain, with the same proportion of water, sometimes more and sometimes less sucrose than corresponds with the solubility of pure sucrose in pure water. The most evident explanation is that, when present in an excess of both sucrose and salt, water can dissolve so much of both as corresponds with the solubility of the new combination formed between the sucrose and the salt. According to that solubility the water can either keep dissolved more or less of the combined sucrose than it had been able to do if the salt had not been present and the sucrose had remained in the uncombined state.

Köhler investigated how much salt was dissolved at the temperature of 31·25° C. in 100 c.cm. of pure water, and how much in 100 c.cm. of a sucrose solution saturated at that same temperature, and finally how many grammes of sucrose were contained in 100 c.cm. of a solution which contains besides that sucrose an excess of the same salts.

As in every case a decreased solubility of the salt coincides with a lower solubility of the sucrose it is evident that in every instance, where both the components occur in such large quantities that they can combine together to their full extent, the solubility of the constituents is regulated by that of their combination and no longer by that of the respective bodies in an uncombined state. In connection with this point Degener† found that the lowest solubilities of salt

* *Zeitschrift für die Rübenzuckerindustrie* 47, 441.
† *Deutsche Zuckerindustrie* 20, 2149.

and sucrose in solutions of these two in water correspond with the formulæ of $NaCl + 4\,C_{12}H_{22}O_{11}$ for the sodium chloride combination, and with $CaCl_2 + 3\,C_{12}H_{22}O_{11}$ for the corresponding calcium chloride combination.

Name of the Salts.	Grammes of Salt in 100 c.cm. of pure water.	Grammes of Salt in 100 c.cm. of Saturated Sucrose Solution.	Sucrose in 100 c.cm. of the Salt Solution.
Potassium Chloride	38·2	44·8	246·5
Potassium Carbonate	95·9	105·4	265·4
Potassium Acetate	286·3	293·5	324·8
Potassium Citrate	159·7	219·0	303·9
Sodium Chloride	35·9	42·3	236·3
Sodium Carbonate	22·0	24·4	229·2
Sodium Acetate	46·9	57·3	237·6
Potassium Sulphate	12·4	10·4	219·0
Potassium Nitrate	47·4	41·9	224·7
Sodium Sulphate	45·4	30·5	183·7
Calcium Acetate	35·4	26·3	190·3
Calcium Chloride	88·5	79·9	135·1
Magnesium Sulphate	47·5	36·0	119·6

In the case of one of the constituents being deficient, it is clear that no more of the combination is formed than corresponds with the amount of that constituent, so that we can no longer find the solubility of the combination only, but have now to take into account the amount of the still uncombined portion of the other constituent too. If it is the salt which is deficient, then there exists in the solution, besides the sucrose in combination, a certain amount of free sucrose, the solubility of which may not be neglected although it may be influenced by the presence of the combination. As these combinations are hydrated bodies we can suppose the solution to consist of: free water, free sucrose, combined water and a sucrose-salt combination. If we wish to ascertain whether the presence of a salt influences the solubility of sucrose in water and in which direction, and with that object only took into account the total amount of sucrose and the total amount of water, we can easily imagine what highly varying results might accrue, according to the different proportion in which the four constituents mutually exist.

When the amount of salt is small and that of sucrose considerable, only a little of the hydrated sucrose-salt combination will be formed, thus very little free sucrose and free water will be withdrawn from the solution, and yet sufficient to prevent the remaining free water from keeping all of the remaining free sucrose in solution, part of the latter crystallizing. We have, therefore, in the remaining portion of free water its full content of sucrose and further in the hydrate a little combined sucrose, and if the sum of these two quantities happens to be smaller than corresponds with the figure for the solubility of sucrose in water, the total amount of sugar in the total amount of water is smaller than the normal value, and we should be inclined to talk of a negative molasses-former. When the amount of salt

increases, then of course the quantity of salt-sucrose combination increases equally, until at the end all of the sucrose has combined with salt, which is why we no longer have to deal with a solution of sucrose in a steadily decreasing amount of free water, but only the solubility of a sucrose-salt combination, which is, as we saw before, always higher than that of the sucrose existing in it. This explains why in Herzfeld's experiments* additions of small portions of non-sugar were apt to lower the solubility of the total sucrose in the total water, whereas larger portions increased it.

In the pure juices and syrups we see instances of the former case; in these products the small amount of the combination is by far less than the free sucrose, and accordingly the solubility of the total sucrose in the total water should rather be lower than higher than the normal figure. In the exhausted molasses, on the contrary, the superfluous sucrose is gradually removed by successive crystallizations and only the saturated sucrose-salt combination is left, and it depends alone on the degree of concentration of this strongly evaporated product how much sucrose is found there *on 100 parts* of water. In the beetroot molasses crystallized in big crystallizing tanks, this amount of water is generally such that the relation between the sucrose and that water is greater than between sucrose and water in a pure saturated sucrose solution, but, as we shall see later on, this is only a surmise; it might have been the reverse as well. But because almost exclusively beetroot molasses was studied, and in this substance the higher proportion was steadily met with, the idea of supersaturated solutions has unconsciously taken root in the minds of all investigators who studied molasses and its formation, and they have always endeavoured to explain that supersaturation by the hypothesis of the presence of substances which prevented crystallization. A short definition of molasses, apart from casual impurities, *i.e.*, of an ideal molasses, is according to my theory: *Molasses is a hydrated, syrupy-liquid combination of sucrose and salts.*

It struck me when entering the cane sugar industry, after all I had learned of beetroot molasses, that the exact relation between sucrose and water in cane molasses was much smaller than corresponds with the solubility of sucrose and water, instead of being higher, as I had always been led to suppose.

At the average Java temperature of about 28 C. one part of water can keep in solution 2·162 parts of sucrose, so that if that solubility was not changed by the presence of the other bodies, in the molasses, the polarization of a molasses with 25% of water should be 53·9. According to the table given underneath of analyses of mother-liquors crystallized in tanks the relation between sucrose and water is generally less than that of the two pure ingredients, and generally those containing the most glucose show the lowest relation.

* *Zeitschrift für die Rübenzuckerindustrie*, 42, 182, 240.

No.	Dry Substance.	Sucrose.	Glucose.	Ash.	Water.	Quotient of Purity.	Sucrose on 100 parts of Water.	Relation between Glucose and Ash.*
0	....	....	....	....	....	100·	216·2	....
1	74·88	59·20	7·29	6·07	25·12	79·06	235·7	1·20
2	74·29	58·70	9·97	3·82	25·71	79·01	228·3	2·61
3	82·88	47·80	14·53	6·66	17·12	57·67	279·2	2·18
4	74·69	50·20	15·14	4·35	25·31	67·21	198·3	3·48
5	82·90	43·70	15·80	6·50	17·10	52·17	255·6	2·43
6	72·23	49·00	16·52	2·52	27·77	67·84	176·4	6·56
7	83·55	47·90	17·44	7·00	16·45	57·33	291·2	2·49
8	71·07	42·90	19·93	3·00	28·93	60·36	148·3	6·64
9	71·55	43·10	20·87	3·39	28·45	60·23	151·5	6·16
10	77·10	34·10	23·00	7·80	22·90	44·23	148·9	2·95
11	71·40	32·40	23·00	5·20	28·60	45·38	113·3	4·42
12	76·80	36·90	26·30	4·97	23·20	48·05	159·1	5·29
13	75·86	30·90	27·47	6·37	24·14	40·73	128·0	4·31
14	73·88	32·90	27·53	3·72	26·12	44·53	126·0	7·40
15	80·90	35·30	27·60	8·08	19·10	43·63	184·8	3·42
16	74·62	34·05	27·78	4·16	25·38	45·63	134·2	6·68
17	75·50	33·70	28·12	3·65	24·50	44·64	137·6	7·70
18	77·02	33·80	28·20	6·88	22·98	43·88	147·1	4·10
19	73·78	32·19	30·30	3·77	26·22	43·64	122·8	8·04
20	74·23	30·69	31·73	3·65	25·77	41·34	119·1	8·69

* At 28°C.

This appears very strange, since in existing literature glucose is always quoted in the front ranks of the molasses-formers, and one would expect high solubilities, instead of the low values found by actual analysis. Gunning* has said that glucose renders a certain amount of sucrose uncrystallizable. Pellet† put down the melassigenic coefficient of glucose as 0·60. Flourens‡ allows various values for that figure, fluctuating between 0·30 and 1·0, whilst Degener§ mentions having found glucose to possess no melassigenic power of its own, but to be able to transform sucrose into invert sugar by the action of its acid products of decomposition. In that same connection Pellet† also mentions two distinct sources of molasses-forming by glucose, namely one as a consequence of the inverting action of glucose, which he calculates as 0·16, and further the pure melassigenic power, at a value of 0·60. The alleged inverting action,

* Saccharimatrie en accyns.
† *Zeitschrift für die Rübenzuckerindustrie* 1879, 806.
‡ *Journal des Fabricants de Sucre* 1880, 40.
§ *Zeitschrift für die Rübenzuckerindustrie* 1881, 514.

which has, however, never been proved to exist, may be ruled out of consideration here, where only the melassigenic power itself is considered.

While many authors thus ascribe very different values to the melassigenic power of the glucose, I have made some experiments to ascertain first of all how far this sugar influences the solubility of sucrose in water.

To this end solutions were made, each containing the same amount of sucrose and of water, but varying amounts of glucose. They consisted of 25 grammes of sucrose, 7·5 grammes of water, and respectively 0, 0·5, 1, 3, 6, 12·5 and 25 grammes of invert sugar or glucose.

The three constituents were dissolved by heat and put aside after being cooled for crystallization after the addition of a few sucrose crystals in order to promote the crystallization of the superfluous sucrose. After an interval long enough to permit all of the crystallizable sucrose forming into crystals, for which I estimated a month to be amply sufficient, the crystals were separated from the mother-liquor and both analysed separately. The result of these analyses was that in every case practically the same amount of sucrose had crystallized out, as is shown in the table here.

	1	2	3	4	5	6	7
Sucrose crystallized out	9·3	9·1	10·0	8·9	9·8	9·2	9·0
Sucrose dissolved	15·7	15·9	15·0	16·1	15·2	15·8	16·0
Invert Sugar	25·0	12·5	6·0	3·0	1·0	·5	—
Water	7·5	7·5	7·5	7·5	7·5	7·5	7·5

In every one of the mixtures, the amount of sucrose remaining dissolved in the water was therefore the same, showing that the solubility of sucrose in water in which already thrice its weight of glucose was dissolved was exactly the same as in water without any addition of glucose. In sample No. 1, 100 parts of water dissolved 210 parts of sucrose, while in No. 7, the solubility amounted to 213·3 parts in 100. It is evident that glucose has no influence whatever on the amount of sugar crystallized out.

I repeated the experiment and determined also the composition of the resulting mother-liquor.

120 grammes of sucrose and 50 grammes of water were mixed, and to four of such mixtures I added respectively 7·5, 15, 30, and 60 grammes of invert sugar. The mixtures were raised to boiling-point until completely dissolved, sterilized in a Koch's sterilizer, and cooled. After that I added two grammes of sharp-edged sucrose crystals to start crystallization, and kept the mixtures aside in a relatively cool place, where the temperature never rose above 29° C. After six weeks' standing I analysed the samples with the following results. In the figure for the weight of sucrose crystallized out allowance is already made for the two grammes of sugar added after the cooling.

Constituents.	Invert Sugar.				
	0.	7·5.	15.	30.	60.
Weight in Grammes :—					
Sucrose crystallized out	14	14	15	15	14
Sucrose dissolved	106	106	104	105	105
Sucrose inverted	0	0	1	0	1
Composition of the Mother-Liquor in %:					
Sucrose	67·6	64·1	60·9	56·2	48·7
Invert sugar	0·1	5·3	9·7	16·7	27·5
Ash	0·1	0·1	0·1	0·2	0·2
Water	32·0	30·3	29·1	26·6	23·25
Undetermined	0·2	0·2	0·2	0·3	0·35
Sucrose on 100 water	211	212	209	211	210

The table shows very clearly that, contrary to the opinion of many authors on this subject, glucose or invert sugar alone does not affect the solubility of sucrose, and also that this sugar does not possess an inverting action of its own. Neither can the other constituents of the molasses be made responsible for the observed lowering of the solubility of sucrose in the water of the cane sugar molasses, because they—organic and inorganic salts, pectine, gums, nitrogenous bodies, caramel, &c.,—are also found in beetroot molasses, and even there are looked upon as the very sources of the higher solubility of the sucrose.

I therefore presumed that possibly a joint action of invert sugar and salts tended to cause the phenomenon alluded to here; so I again prepared solutions containing the same amount of sucrose and of water, but this time using varying amounts of glucose and of an organic acid salt, potassium acetate.

After the superfluous sugar had crystallized out, it was weighed and the figures are given underneath:—

Constituents in grammes.	1	2	3	4	5	6	7
Total sucrose..	25	25	25	25	25	25	25
Sucrose crystallized out.	9·2	9·1	6	3·1	11·6	10·7	6·7
Sucrose dissolved	15·8	15·9	19	21·9	13·4	14·3	18·3
Glucose	—	—	—	—	10	10	10
Potassium acetate	—	1	2	5	1	2	5
Water..	7·5	7·5	7·5	7·5	7·5	7·5	7·5
Sucrose on 100 water..	210·7	212·0	253·3	292·0	178·7	190·7	244·0

When repeating the experiment on a larger scale I also found opportunity to analyse the mother-liquors. The mixtures consisted of 120 or 150 grammes of sucrose, 30 grammes of invert sugar, 50 grammes of water, and 0, 1, 5, 10, 20, 30, and 40 grammes respectively of potassium acetate. After complete crystallization, the analyses were as follows :—

Constituents.	Grammes of Potassium Acetate.						
	0	1	5	10	20	30	40
Weight in grammes :—							
Total sucrose..	120	120	120	120	120	150	150
Sucrose crystallized out.	15	45	25	16	3	18	6
Sucrose dissolved	105	75	94	104	115	132	144
Sucrose inverted	—	—	1	—	2	—	—
Composition of the liquid in per cent. :—							
Sucrose	56·2	48·0	52·9	53·8	53·4	54·6	53·8
Glucose	16·7	18·2	15·8	15·0	13·97	12·37	11·6
Ash	0·2	0·88	2·29	3·54	6·51	8·70	10·56
Water..	26·6	32·07	28·11	25·81	23·21	20·78	18·10
Undetermined	0·3	0·85	0·90	1·75	2·91	3·55	5·94
Glucose : Ash	—	20·7	6·9	4·3	2·1	1·4	1·1
Sucrose on 100 water ..	211	150	188	209	230	263	297

We see from the tables that glucose unaccompanied by salts does not interefere with the solubility of the sucrose ; that the organic acid salt without addition of glucose causes more sucrose to remain dissolved, but that the combination of glucose and organic salts strongly decreases the solubility of the sucrose in case of a high quotient between glucose and salt, and increases the same when the quotient between glucose and ash is low.

(To be continued.)

The total yield of unrefined cane sugar this year in India is estimated at 1,897,000 tons for all the provinces except Bombay, being a decrease of 14 per cent. as compared with last year.

The imports of foreign sugar (excluding confectionery and molasses), into British India for the 11 months ending February, 1908, amounted to 9,256,482 cwts., an increase over 1907 of 16,155 cwts. The bulk came from Java (6,179,036 cwts.), Mauritius (2,332,212 cwts.), and Austria-Hungary (625,276 cwts.).

A THEORY OF THE EXTRACTION OF JUICE BY MILLING.*

By Noël Deerr.

The process adopted to extract the sugar from the canes may be divided into two parts:

1. The crushing of the canes without the addition of water or other diluent; this I shall refer to as the "Dry crushing."

2. The extraction of the residual juice left after the dry crushing by the saturation of the dry crushed bagasse with water or diluted juice, and subsequent recrushing. This I shall refer to as the "Saturated crushing."

In the simple algebraic formulae developed here f denotes the fibre per unit weight of cane, m denotes the fibre per unit weight of bagasse, and w denotes the water added in the saturation of the bagasse per unit weight of cane.

Preliminary considerations.—If f and m have the significance already attributed to them, then the weight of bagasse per unit weight of cane is $\frac{f}{m}$ and the weight of the juice expressed is $\frac{m-f}{m}$. The weight of juice in unit weight of cane is $1-f$, so that the juice extracted per unit weight of juice in the cane is $\frac{m-f}{m(1-f)}$.

The weight of juice remaining in the bagasse is $\frac{f(1-m)}{m}$, and the juice lost in the bagasse per unit weight of juice in the cane is $\frac{f(1-m)}{m(1-f)}$. Owing to the first expressed juice being richer than that left in the bagasse, the extraction per 100 sucrose in cane is higher than is indicated by the formula $\frac{m-f}{m(1-f)}$.

If the sugar value of the expressed juice is indicated by unity and the sugar value of the residual juice by a, then the sugar value of all the juice in the cane is represented by

$$\frac{m-f}{m} + \frac{af(1-m)}{m} = \frac{m+af-f-afm}{m}$$

and the extraction will be given by the formula

$$\frac{m-f}{m} \div \frac{m+af-f-afm}{m} = \frac{m-f}{m+af-f-afm}$$

With canes containing 12% of fibre and thereabouts, and dry crushed to 45% of fibre or thereabouts, it will be found on trial that the residual juice in the bagasse contains a percentage of sugar about 85% of that contained in the expressed juice; if, then, for a ·85 be substituted it

* From H.S.P.A. Bulletin No. 22 (Div. of Agr. and Chem.).

will be found that the extraction of sucrose is from 2·5% to 3·0% higher than is indicated by the formula $\frac{m-f}{m(1-f)}$. The variation depends on the amount of fibre in the cane, and on the relation between expressed and residual juice.

As typical of the results obtained in a modern mill I take 45% of fibre in dry crushed bagasse as representative of good modern work. In Table I. I have calculated out the extraction obtained, when canes containing 10% to 14% of fibre are dry crushed to 45% of fibre, allowing an increase in the extraction of 3% over and above that indicated by the formula $\frac{m-f}{m(1-f)}$, so as to allow for the decreased sugar value of the residual juice in the bagasse.

TABLE I.

Fibre in Cane.	Extraction.	Fibre in Cane.	Extraction.
10·	89·01	12·5	85·00
10·5	88·23	13·	84·17
11·	87·42	13·5	83·34
11·5	86·64	14·	82·50
12·	85·82		

The Effect of the Added Water.

To $\frac{f}{m}$ bagasse obtained in the dry crushing let w water be added per unit weight of cane; let this water mix completely with the residual juice in the bagasse, the weight of which per unit of cane is $\frac{f(1-m)}{m}$. The weight of the bagasse and water is then

$$\frac{f}{m} + w = \frac{f + wm}{m}$$

and the residual juice in this bagasse is, as has already been shown, $\frac{f(1-m)}{m}$ so that the weight of diluted juice is

$$\frac{f(1-m)}{m} + w = \frac{f + wm - fm}{m}$$

If this saturated bagasse be crushed until it again contains m more per unit weight of bagasse, evidently the weight of diluted juice obtained is w and the proportion obtained of that originally present is

$$w \div \frac{f + wm - fm}{m} = \frac{wm}{f + wm - fm}$$

If the content of fibre in the dry crushed bagasse be m, and in the saturated crushed bagasse m', the proportion of sugar obtained of that

actually present may be found in this way. To $\frac{f}{m}$ bagasse let w water be added; as before the weight of bagasse now is $\frac{f + wm}{m}$, and it contains $\frac{fm}{f + wm}$ fibre. Let this bagasse be crushed to m' fibre, when the weight of the bagasse becomes $\frac{f}{m'}$ and the weight of the diluted juice obtained is $\frac{f + wm}{m} - \frac{f}{m'} = \frac{m'(f + wm) - fm}{mm'}$. The whole weight of diluted juice in the saturated bagasse is $\frac{f + wm - fm}{m}$, so that the proportion obtained is

$$\frac{m'(f + wm) - fm}{mm'} \div \frac{f + wm - fm}{m} = \frac{m'(f + wm) - fm}{m'(f + wm - fm)}.$$

These expressions may be used as the basis of a theory of the extraction of sugar from canes and incidently to form a system of control.

Single Maceration.

By this term I mean a process where the canes after the preliminary dry crushing are saturated once with water and again crushed, as opposed to a process entailing the return of the diluted third mill juices. I mentioned above that I took 45% of fibre in dry crushed bagasse as typical of good modern work; in the crop of 1907 the average fibre in the final bagasse in 25 Hawaiian factories was 49·65%, and I shall take 50% of fibre in the final bagasse as representative of good modern work. In Table No. II., I have calculated out what proportion of the sugar in the cane is obtained by a single maceration, with complete admixture, for different amounts of added water, in all cases after the canes have been dry crushed to 45% of fibre and after allowance as already detailed has been made for the decreased sugar value of the residual juice in the bagasse. It follows as a result of the equation, and as can be seen from an inspection of the table, that as the quantity of water added increases, the sugar obtained per unit of water added rapidly decreases; for example, with canes containing 10% of fibre, the addition of 10% of water corresponds to an increase in the extraction of 6%, and if 30% of water be added the extraction due to the water is 8·4%, an increase of only 2·4% for an addition of 20% of water.

The proportion of sugar extracted due to the dry crushing, and due to saturation, varies in accordance with the fibre in the cane; as the fibre increases, more sugar is left in the dry crushed bagasse, and a greater proportion is obtained, due to the saturated crushing; the admixture of the added water is never complete, and hence with high fibre in cane it becomes of greater importance to carefully check the admixture of the added water, and to obtain as efficient a dry crushing as is possible.

Table II.

Showing the maximum extraction to be obtained with single maceration, with complete admixture of added water; dry crushed bagasse containing 45% fibre, and saturated crushed bagasse containing 50% fibre.

Extraction due to saturation in upper, and total extraction in lower, line.

Fibre per 100 cane.	Water added per 100 cane.								
	10	15	20	25	30	35	40	45	50
10·	6·04	6·95	7·58	8·04	8·39	8·66	8·88	9·07	9·22
	95·05	95·96	96·59	97·05	97·40	97·67	97·89	98·08	98·23
10·5	6·36	7·33	8·00	8·50	8·88	9·18	9·41	9·61	9·80
	94·59	95·56	96·23	96·73	97·11	97·41	97·64	97·84	98·03
11·	6·68	7·71	8·44	8·98	9·39	9·72	9·99	10·21	10·40
	94·10	95·13	95·86	96·40	96·81	97·14	97·41	97·63	97·80
11·5	6·97	8·07	8·85	9·43	9·87	10·23	10·51	10·76	10·96
	93·61	94·71	95·49	96·07	96·51	96·87	97·15	97·40	97·60
12·	7·28	8·44	9·27	9·89	10·37	10·75	11·07	11·33	11·55
	93·10	94·26	95·09	95·71	96·19	96·57	96·89	97·15	97·37
12·5	7·58	8·81	9·68	10·34	10·86	11·27	11·61	11·89	12·13
	92·58	93·81	94·68	95·34	95·86	96·27	96·61	96·89	97·13
13·	7·87	9·17	10·09	10·80	11·35	11·70	12·15	12·45	12·71
	92·04	93·34	94·26	94·97	95·52	95·96	96·32	96·62	96·88
13·5	8·17	9·52	10·50	11·24	11·82	12·29	12·68	13·00	13·27
	91·51	92·86	93·84	94·58	95·16	95·63	96·02	96·34	96·61
14·	8·46	9·87	10·90	11·68	12·30	12·80	13·21	13·55	13·85
	90·96	92·37	93·40	94·18	94·80	95·30	95·71	96·05	96·35

Double Maceration.

Instead of applying the water in one dose it may, in a twelve roller mill, be applied in two, a portion after the preliminary dry crushing, and a portion after the saturated bagasse has been crushed in the third mill. The calculation of the extraction with complete admixture and upon the same data as before can be made as follows:—

In the case of a cane with 10% of fibre crushed in the preliminary dry crushing to 45% of fibre, and then after the addition of water 10% on the weight of the cane, crushed to 50% of fibre, the total extraction (see Table II.) is 95·05%, leaving 4·95% in the bagasse. To this bagasse let water 10% on weight of cane be again added with

complete admixture, and let the bagasse saturated for the second time be again crushed to 50% of fibre; then of the sugar remaining $\frac{wm}{f + wm - fm}$ part is obtained in the expressed diluted juice. Substituting for w ·10, for m ·50, and for f ·10, this expression becomes ·5. Hence of the 4·95 sugar in the already partially treated bagasse $\cdot 5 \times 4 \cdot 95 = 2 \cdot 475$ is obtained, making the total extraction under these conditions $95 \cdot 05 + 2 \cdot 47 = 97 \cdot 52$, compared with the 96·61 obtained under equal conditions, except that the water was added in one dose. In Table III. I have calculated the possible extractions on the supposition that the canes are first crushed to a fibre content of 45%, and then twice in succession to a fibre content of 50%; water 10%, 15%, &c., being applied behind the second and third mills.

TABLE III.

Fibre per 100 cane.	Water added per 100 cane.			
	20	30	40	50
10·	8·51	9·37	9·85	10·15
	97·52	98·38	98·86	99·16
10·5	9·00	9·94	10·47	10·80
	97·23	98·17	98·70	99·03
11·	9·49	10·52	11·11	11·48
	96·91	97·94	98·53	98·90
11·5	9·94	11·06	11·71	12·12
	96·58	97·70	98·35	98·76
12·	10·42	11·63	12·34	12·79
	96·24	97·45	98·16	98·61
12·5	10·88	12·19	12·95	13·45
	95·88	97·19	97·95	98·45
13·	11·33	12·74	13·57	14·11
	95·50	96·91	97·74	98·28
13·5	11·78	13·28	14·18	14·66
	95·12	96·62	97·52	98·00
14·	12·23	13·82	14·78	15·41
	94·73	96·32	97·28	97·91

The Return of Diluted Juices.

The highest possible efficiency of the added water occurs when the diluted juices from the last mill are used to saturate the bagasse coming from a preceding mill; a complete algebraical expression

representing this system of working is not easy to obtain, and when it is obtained it is not elegant. A comparison of working with water only, and with return of diluted juices is best shown by means of a worked out example.

Let the milling plant be a twelve roller mill; the canes are subjected to a dry crushing in the first six rollers until the percentage of fibre is 45%; water 30% on weight of cane is then added behind the *third* mill, and the diluted juices coming from the fourth mill are used to saturate the bagasse coming from the dry crushing; in the third and fourth crushings the bagasse is taken as having 50% of fibre; the cane is assumed to have 12% of fibre, and the same allowance as heretofore is made for the decreased sugar value of the residual juice in the bagasse and complete admixture of the diluents is assumed.

Canes containing 12% of fibre when crushed to 45% of fibre will on the lines already established afford in the expressed juice 85·82% of the sugar originally present, leaving 14·18% in the dry crushed bagasse; to this 14·18 let 30 water per 100 cane be added, and let the saturated bagasse be crushed to 50% of fibre; then applying the formula $\frac{m'(f + wm) - fm}{m'(f + wm - fm)}$ an extraction of 10·36 per 100 sugar in cane is obtained in this saturated crushing. Let the diluted juice containing this 10·36 sugar be applied to the dry crushed bagasse; the first effect of returning this diluted juice is to reduce the extraction from 85·82% to 85·82 — 10·36 = 75·46%, leaving 24·54% in the bagasse. If this saturated bagasse be crushed to 50% of fibre, 73·1% of the sugar it contains is obtained; ·731 × 24·54 = 17·94, so that the extraction at this stage is 76·54 + 17·94 = 93·40, and 6·60% is left in the bagasse as it now leaves the third mill. To this crushed saturated bagasse let 30 water per 100 cane be added, and let it be again crushed to 50% of fibre; then of the sugar present 55·5% is obtained; ·555 × 6·60 = 3·66, so that the extraction has now reached 93·40 + 3·66 = 97·06%. Now let the 3·66 sugar contained in diluted juice be applied to the dry crushed bagasse, so that the extraction is reduced to 85·82 — 3·66 = 82·16, there now being 17·84% in the bagasse; as before, 73·1% of this, or 13·04, is extracted in the third mill, making the total extraction at this stage 82·16 + 13·04 = 95·20, and leaving 4·80% in the bagasse; again adding 30 water, 55·5% of this, or 2·76% is obtained in the fourth mill, so that the total extraction now is 95·20 + 2·66 = 97·86%.

Proceeding in this way, and calculating the successive extractions by a series of steps, it is noticed that each successive addition to the extraction becomes smaller and smaller, until no appreciable difference between any two consecutive extractions is found; in this case the limiting value is found to be practically 98·0%.

Under equal conditions, but with the water applied half after the second and half after the third mill, and no return of diluted juice, the extraction was found to be 97·44.

For the purpose of convenient comparison, I collect here comparative data calculated on the lines followed above :—

If the extraction in a nine roller mill with single maceration is .. .. 96·18

Then the extraction in a twelve roller mill with the same quantity of water added in two portions is . .. .. 97·44

And if all the water be added after the third mill, and the last mill juice be returned behind the second mill, then the extraction is .. .. 98·00

I have not included any calculation of divided addition of water, or of return of diluted juices in a nine roller mill, as generally the bagasse coming from the first mill is not sufficiently well crushed to absorb a diluent, so as to obtain any useful effect.

The Effect of an Inferior Dry Crushing.

Instead of taking 45% of fibre in the dry crushed bagasse, let the percentage of fibre be 40%. Then if the canes contain 12% of fibre, the extraction due to dry crushing is 81·93%, leaving 18·07% in the bagasse; let this bagasse after the addition of water be crushed to 50% of fibre; below I have calculated what will be the extraction with single maceration after the addition of water 10%, 20%, &c., on cane, and for the purpose of comparison add the figures already obtained when the dry crushed bagasse contains 45% of fibre.

	Water added per 100 cane.				
	10	20	30	40	50
40% of fibre in dry crushed bagasse	92·26	94·29	95·48	96·26	96·80
45% of fibre in dry crushed bagasse	93·10	95·09	96·19	96·89	97·37

The advantage in favour of the more effective dry crushing is in reality greater than is shown in the above calculation; complete admixture is in both cases assured; in practice we do not obtain complete admixture, but the admixture will be the less imperfect the more the bagasse is disintegrated; that is to say, when the fibre content is higher.

(To be continued.)

The New Vere Central Sugar Factory in Jamaica was opened at the end of March by the Governor in the presence of a large gathering of planters and other interested persons.

STUDIES IN SUGAR MANUFACTURE.*

By A. Aulard.

I am glad to be able to tell my colleagues in France and Belgium, that I have gleaned much information of interest in the course of my journey of investigation, from Nov. 20th to Dec. 11th, amongst the sucreries and refineries of Bohemia, Austria, and North Germany.

Contrary to what has been the case during the past year in France and Belgium, the Bohemian beets have proved to be of exceptional richness and purity; it is necessary that this should be borne in mind in considering the nature of the communication which I am about to impart, as much of it deals with the purities of the products to be boiled.

Bohemia is a small kingdom, as prosperous as Belgium, to which it can be compared as regards the number, activity, and intelligence of its inhabitants, its big engineering works, its intensive culture and its sugar cultivation. Last campaign it was the Eldorado of the beet cultivator. Professor Andrlik of Prague mentioned to me several usines working up beets yielding more than 20% of sugar in the root (hot water digestion method).

I have visited some of them working beets of more than 19% and at Nymburg under Hanus Karlik the general average of the 40,000 tons worked up was 18·05% sugar in the roots; the year 1906-07 gave an average of no more than 16·03%.

Before starting on a description of the technical side of my experiences, it is worth while referring parenthetically to the difference which exists between the method of buying the raw material in France and Belgium, and that adopted in Austria-Hungary and Germany.

M. Karlik told me that he paid for his beets, delivered at the usine, 20 crowns (21 frs.) per metric ton. Admitting that not all are so delivered, it is necessary in this case to increase the price by another franc. The beets containing 18% of sugar then cost him 22 frs. plus the price of 50% of pulp returned gratuitously. If we calculate this pulp as worth 7 frs. per metric ton (the price paid last year) it will amount to $·50 \times 7 = 3·50$ frs. Hence the cost of the ton of beets of 18% content is 25·50 frs. in all.

In Belgium a similar beet would cost 23 frs. for 14% content, with about a franc extra for transport, making 24 frs.; 4 degrees at 2 frs. = 8 frs. (presuming we do not pay 2·50 frs. as is done at some usines) making 32 frs. From this has to be deducted 50% of pulp at 7 frs. = 3·50 frs., so that the net sum is 28·50 frs. or 3 frs. more per ton than in Bohemia. This difference is still further accentuated in the cost of manufacture, for with juice giving syrups of 95 purity, as M. Karlik obtains them, more sugar is extracted from them, and that in a more economical manner than is the case when dealing with beets which give juices of 93 purity or even less. Whatever sugar content there

* Translated from the *Bulletin des Chimistes*.

be as in Belgium or density as in France, it is certain that in Austria and Germany, which countries from the point of view of buying raw material are in no wise versed in the analytical fallacies of our sugar rhetoricians, the advantage possessed over us is incontestable; not only have they better beets—richer and purer—than in Belgium but moreover they pay for them by weight, thus avoiding the endless disputes with the cultivators.

The usine of Nymburg, which has been modernized since the occasion of my last visit some years ago, deserves special mention amongst all the numerous usines I visited in the course of my journey; it is almost the cradle of the third carbonatation process of which M. Karlik was the inventor, and I question whether it was not also the first place to instal single carbonatation such as I got a glimpse of ten years ago.

I was present at some experiments the results of which I am not yet at liberty to divulge, as Professor Andrlik wishes to bring them to a successful conclusion. But while thus engaged I was able to study in detail the Karlik boiling apparatus.

In order to fully understand the working of this apparatus, it is first necessary to give some description of the usine and its method of working.

Two beet slicers, fitted with 12 to 14 knife-holders furnished with Goller knives in one piece (this, to my mind, is a mistake), produce fine chips $1\frac{1}{2}$ mm. thick; 16 diffusers of 60 hectolitres capacity, arranged in two rows, receive them. These diffusers are very well constructed of a light and handsome design; they are closed by means of iron bascule doors fitted with double doors of perforated sheet iron, thus forming a strainer. There is no doubt that this arrangement which does away as much as possible with objectionable spaces is worthy of recommendation; at Nymburg as well as at Vrdy and Leopoldsdorf, the diffusers are of the Breitfeld type and just as efficient. The juice on issuing forth has a very high density; its mean purity is seldom less than 91.

Here are the figures of the working of the battery during five working days:—

Sugar in the Beet.	Brix.	Sugar in the Diffusion Juice.	Purity.	Diffusion Losses.	Yield of Juice. k.
17·6	..	15·57	..	0·320	110·90
17·35	..	15·55	..	0·270	109·90
17·25	..	15·34	..	0·330	110·2
17·00	..	15·15	..	0·270	110·40
17·50	..	15·55	..	0·210	111·18
18·05	..	15·70	..	0·320	112·99
18·85	18·43	16·83	91·32	0·300	110·27
18·80	18·00	16·45	91·38	0·310	112·34
18·90	18·31	16·67	91·04	0·305	111·66
18·45	17·81	15·96	89·61	0·295	113·56
18·75	18·41	16·56	89·95	0·300	..
18·05	18·192	15·94	90·66	0·293	112·23

Mean density about 1069.

In employing the Naudet process of forced circulation, only 98 to 100 litres of juice are produced, but they are denser and purer. This usine worked up rather more than 40,000 tons in 60 days, equal to 667 tons per 24 hours.

During the last day of manufacture beets which had been siloed for a month gave richnesses of 19·1, 19·1, 18·0, 18·9, and 19·2 per cent. of sugar with diffusion juices having the following composition :—

Brix.		Sugar in Diffusion Juice.		Purity
19·3	..	17·3	..	89·63
18·3	..	16·4	..	89·61
18·8	..	17·0	..	90·42
18·2	..	16·5	..	90·65

Mean purity of diffusion juice on the last day of the campaign as per my analyses, 90·08.

It is certain that the products arising from such beets cannot be compared with the juices of the beets cultivated in Italy, which will not stand siloing, neither will Spanish beets, nor those grown in many French districts. The unprecedented prosperity of the Austro-Hungarian sugar industry is thus due in the first place to the excellence of the available raw material, and to the low price paid for the same; in the second place, to the careful disposition of the usines and their supply areas; the art of the constructing engineer has here reached a truly remarkable standard of excellence.

The diffusion juice is measured very accurately in two measuring receptacles shaped like a bottle, and fitted with glass level gauges. M. Karlik adds to the first carbonatation 2 to 2¼ kg. of lime per 100, and the same amount to the second carbonatation. In the average he employs about 2½ kg. of lime by weight, *i.e.*, 667 tons × 2·5 kg. = 16,675 kg. per 24 hours. The juices are carbonated very rapidly in excellent Karlik patent heaters; these latter, which have often been described, dispense with all the use of grease and scum-clearing steam.

The first carbonatation is carried out in five Karlik heaters, the second in four, and the third in three square heaters. The first carbonatation has an alkalinity of 0·090, the second one of 0·060, and the third one of 0·010, all determined by means of phenol-phthalein test-paper, specially prepared by M. Karlik for his own use. These papers are much used in several factories in Italy, and their application is extending as they give excellent results. All the same, it is best that the laboratory should keep close control over the carbonatation, the alkalinity never being so accurately ascertained as when litmus is used as indicator.

The scums, as at most other sucreries, contain from 0·15 to 1 per cent. of sugar, the pressure with which the presses are refilled being 3 kg. Yet it must be remarked here that this result is obtained with a minimum of water, no more than 60 litres per press being used, which is equal to 120 per cent. of the scums.

One point about Nymburg is that there the scums are disposed of during the manufacture. The agriculturists who take them have a decided liking for them, which is not the same in France or Belgium where the scums are richer in fertilizing material owing to the beets being poorer and possessing more organic matter. Is not this a further proof of the practical intelligence of the Czech agriculturists that they not only produce excellent beets but also know that the scums of defecation are a powerful aid to the nitrification of the soil of their fields?

At Nymburg, for the second and third carbonatations, excellent low-pressure Danek filters are used. All the boilings, save that of diffusion, which is accomplished by the injection of steam, can by means of heaters be arranged for multiple circulations from 8 to 14, according to the nature of the juice and the temperature which it is desired to obtain.

For the green syrups there are four heaters having 14 coils, of which two take off the steam from the fourth body and two that from the first body; these heaters may be worked singly or in combination, thus allowing cleaning to be done during the campaign. There is one heater (an old evaporating pan) for the juice which has passed through the filter presses (which have 30 plates, 650 by 650 mm.) and which delivers its steam to the first evaporator; a fourteen-coil heater after the filtration of the third carbonatation juice, and one after the filtration of the third carbonatation juice. The patent Karlik evaporator has a moving mechanism; it serves as a boiling-down pan. A number of small brass tubes in clusters divided by two tubular plates of bronze, forming the heating chamber, which has an arched bottom of sheet iron, are placed in communication with the waste steam by means of a hollow pivot.

The juice is stirred continuously, and is raised to a temperature of 104° to 106° C. By this means the bicarbonate of lime is decomposed and changed into carbonate; the turbid juice is then passed through Danek filters, the precipitate remaining in the latter. In this way the juices destined for evaporation get quite limpid, and all subsequent boilings fail to produce any turbidness. The juice goes into chest A of the first body under a pressure of 4kg. of steam; it circulates in chests A and B of the first vessel, where a pressure of $\frac{2}{10}$ of an atmosphere is maintained at 106° to 108°. In the second vessel there is 1 to 2 cm. of vacuum at about 97° C. The third vessel is composed of three small vertical chests. In chest A 28 cm. of vacuum were noticed; in chest B 33 cm.; in C 35 cm. In the fourth vessel there was a vacuum of 64 – 65 cm. at about 60° C.

In this vessel the juice was blown, somewhat arbitrarily it seemed to me, with sulphurous acid gas obtained from the combustion of sulphur in a retort by the side of the vessel. The Brix of the syrup

was 58 to 60 per 100 grammes; it was limpid and very faint-coloured. Its clear pale-yellow tint is certainly as fine as the tint of most second carbonatation juices in Italy, Spain, France, and Belgium. The purity of such a syrup is never less than 95, and sometimes attains to 97. In such circumstances why not produce very fine raw sugar, and in the course of treating more than 40,000 tons have only forty boilings of first jet runnings and less than 1·5 % of molasses?

As I wrote more than 15 years ago, if carbonatation is carried out properly, the temperatures rigorously adhered to, and the boiling undertaken preferably before entering into the first body of the evaporator, then this last operation will complete the course of manufacture without any necessity for further cleansing; this is what M. Karlik does and what M. Puvrez de Groulart has so well insisted on in his judicious report presented to the general assembly of the *Societé Technique et Chemique de Sucrerie de Belgique* on May 6, 1903. His report is worth studying; it contains much that appeals to one.

The Karlik usine already described by M. Puvrez shows what can be done by an inventive and industrious man, aided by the best of staffs and excellent engineers; at each step one encounters pleasing modifications of existing apparatus or even complete variations as the case may be, all under Karlik patents. I was surprised after all I had seen in France, Belgium, Italy, Spain, and Russia, to find that for a work of almost 700 tons of beets per 24 hours the Nymburg usine only requires two boiling pans, one for first jets and the other for seconds, and I was even more surprised to find that this sucrerie, without a fill-house, had only three crystallisers-in-motion; each of these had 250 hectolitres capacity, and with very simple methods it was able to produce all the raw first jet sugar at 90° of titrage and molasses of 57 to 59 purity.

The first jet boiling apparatus is shaped like a chest, and has a total capacity of 300 hectolitres; the amount of juice boiled at a time is from 225 to 230 hectolitres, and the period required is 6 to 6½ hours under a steam pressure of 1kg. (atmospheric pressure increased by means of a little live steam.) Thus in 60 hours 212 boilings of 360 quintals each are accomplished. The masse-cuite is cooled to a very concentrated condition; it may be considered as sugar seeing that it leaves no more than 3 to 4% of water in the flat rectangular baths out of which it is shovelled by hand into a narrow helice which conveys it to a dividing mill situated over some trucks, which feed three Haempl centrifugals; only two of the latter are at work, the third being held in reserve.

I cannot speak so highly of the working of the first jet masse-cuite as carried out at Nymburg; the cooling of the cuite requires the services of six men to open the six exit valves of the apparatus; it is never necessary to apply pressure to the cuite if the running which is

yielded has as at Nymburg 78 to 80 of purity. It might be pressed a little less, say at 5%, be cooled in malaxeurs and be brought to a degree of homogeneity greater than is the case six hours after cooling.

The Haempl centrifugal needs little power and works wonderfully well; two machines are sufficient for an output of 700,000 kg. and for machines designed for centrifugalling preparatory to the final centrifugalling for fine crystallized, I consider them to be the best and most practical. They give a beautiful sugar, easy to dry and very homogeneous. Two men and two youths suffice to deal with more than 4,350 sacks of sugar per 24 hours. The result as compared with the usage in Italy points to great simplicity and economy. The first jet sugar joins that of the second jet at the bottom of the elevator which raises the sugar to the top of the usine; from this elevator the sugar passes through a rotatory sifter whence it falls into carriers, which are all weighed, and then deposited in the upper granary. From the latter the sugar is projected in pyramidal heaps on to the middle floor, and from there down to the sacking store. All this work is accomplished by women as is the case in several other branches of the work, such as discharging the beets, pulp, sugar, &c. In such jobs the female worker in Bohemia occupies a preponderating position; as one consequence the cost of labour is thereby lessened.

I now come to the subject of the Karlik boiling, the principal object of my journey of inspection. The raw centrifugal runnings from the masse-cuites without any additions have a quotient of purity of 95 to 97, and are very clear and are necessarily fine and rich in appearance, a little too pure in my opinion, as they attain to a purity of 81. These runnings are diluted with water used in the desugarizing of the Danek sand filters, or else with the wash water of the first carbonatation presses. These are added in a pre-arranged quantity so as to yield 34° Baumé at 35° C. Then a certain amount of milk of lime is added so as to bring the alkalinity to 0·1 gr. of CaO per litre, whereupon the temperature is raised to 95° C.

Sulphitation takes place in movement; as soon as there is no further reaction with Karlik test-paper, the supply of sulphurous acid gas is stopped, and the syrups are pumped into reservoirs fixed over two Danek sand filters; these latter have just lately undergone some alterations which now enable them to be cleaned with expedition, and thus have increased their practical value.

The runnings, on completion of the filtering, are of splendid quality and quite limpid; they show 33 to 34° Baumé at 30° C.

(To be continued.)

CLARIFICATION WITH CAMORSITE.

(From *Louisiana Bulletin*, No. 103.)

Another preparation has recently been offered to some planters and to the Louisiana Sugar Experiment Station under the trade name of Camorsite, to be tried as a clarifying agent. It consists of a heavy white powder, which is partly soluble in water.

An analysis of the material gave these figures:—

	Per cent.
Volatile matter	1·54
Insoluble in hydrochloric acid	8·67
Alumina	31·32
Baryta	57·45
Undetermined	1·02
	100·00

About 90% of the substance consists of an aluminate of barium. But the barium oxide is in excess of what the formula $Ba\,Al_2O_4$ calls for. The ratio of aluminum to barium in barium aluminate is 2 : 1, in Camorsite it is found to be 2 : 1·22. For this reason the preparation is strongly alkaline: 1 g. of it shows an alkalinity equal to 7·25 cc. of normal hydrochloric acid.

Camorsite is partly soluble in water. After boiling it with water the insoluble part amounts to 27·5% of the original weight. The solution has a specific gravity of 1·033 at 21° C.; 100 cc. of this solution contains 0·638 g. of alumina (= 0·338 g. of aluminum) and 2·655 g. of barium oxide (= 2·377 g. of barium). The ratio of aluminum to barium is 2 : 2·8. The solution in water, therefore, contains a much larger excess of free barium oxide than the solid material and is consequently very strongly alkaline; 100 cc. of the solution neutralizes 34 : 1 cc. of normal hydrochloric acid. The solution, on standing in the air, soon becomes turbid, owing to the formation of insoluble barium carbonate. It must therefore always be kept in well stoppered containers.

These analytical data proved the material to be very similar or identical with the barium aluminate with which Zamaron and Dupont conducted a number of experiments, in 1902 and 1903.* These authors claim that the use of barium aluminate offers the following advantages with beet juices:—

1. Increase in purity of 1·5.
2. Increase of the saline quotient up to 1·5.
3. Elimination of lime salts.
4. Reduction of the quantity of lime needed by 50%, and possibility to do without the second carbonation.

* Bull. Assoc. Chim. Sucr. Dis., 21, 59.

5. Decoloration of the juices and syrups.
6. Easy filtration.
7. No incrustations in the evaporators.

A series of laboratory experiments were made at the station, using Camorsite in addition to lime, or in combination with the sulphitation process. Other investigators had found before, and we could confirm this, that the solid preparation cannot be used directly, because it dissolves only very slowly, and that a solution of it should always be employed.

The use of Camorsite without that of lime in the cane sugar industry is entirely out of the question. If employed without sulphitation we would have to introduce into the juice a quantity of water amounting to 5% of the total and with sulphitation up to 16%. Besides this, the precipitate produced by it is flocculent and very voluminous ; after settling, it occupies over one-half of the volume of the liquid. In the third place, the cost per clarifier of 1600 gallons would be about $8 to $10 without, and three times as much if used with sulphitation. The decoloration obtained by neutralizing the juice with Camorsite was good and permanent.

We next made some experiments with a combination of lime and Camorsite. A juice which showed a purity of 82·26 normal, gave after clarification with lime alone 82·52. When we used 3 cc. of Camorsite solution and neutralized the remaining acidity with lime, a purity of 82·92 was obtained. By increasing the quantity of Camorsite solution to 10 cc., the purity could be raised to 83·48.

When Camorsite was used in connection with sulphitation the results obtained were less good. The same juice that had been used before was sulphured to 5 cc. acidity and then treated with lime until a very slight acidity remained. The purity of the clarified juice was 83·86. When 3 cc. of Camorsite solution were substituted for an equivalent quantity of lime, the purity was found to be 83·80. The use of 10 cc. of Camorsite solution resulted in a purity of 83·76.

Even if better results than these could be procured with the use of Camorsite, it could not be recommended for two reasons. The cost per clarifier of 1600 gallons would, according to Mr. Camors' statement, amount to $1·50, which is entirely too high.

The second reason, however, is a much stronger one, and has always prevented the use of compounds of barium which have often been proposed to be used in the sugar industry. While barium salts can be entirely removed by proper processes—we could not detect even a trace of it in the ash of our juices treated with Camorsite—there exists a great danger of the products being contaminated with them through improper use by inexperienced workmen. This consideration alone should prevent the use of barium compounds in the manufacture of articles of food, especially in such cases where other processes are available giving equally good results.

ABSTRACTS, SCIENTIFIC AND TECHNICAL.*

Hot and Ordinary Diffusion Processes. *J. Dostál. Zeit. Zuckerind, Böhm., 1908, 32, 280-290.*

It would appear that the hot diffusion process is coming into practice in beetroot sugar manufacture. The author has conducted a number of experiments with the object of comparing the two different methods. The results of his investigations show that the hot diffusion process has the following advantages:—(1) Diffusion juices of a greater density and a higher coefficient of purity are always obtained. (2) An appreciable saving in live steam is effected when the juices in the circulation heaters are heated by steam from the evaporators. (3) The heating of the diffusion battery without an injector is regular and independent of the battery-man. The juices do not become diluted by the water condensed from the live steam of the injector. (4) Loss of sugar by the action of micro-organisms on the diffusion juices is reduced to a minimum.

Utilization of Residuary Molasses. *Paul Rinckleben. Chem. Zeit., 1908, 32, 343-345, 358-361.*

In Germany, the residues from the desugarization of beet molasses and the spent washes of molasses distilleries were, up to the year 1894, worked up only for the carbon they yielded on dry distillation. Since that time a large number of experiments have been carried out with the object of utilizing the nitrogen contained in them in a rational and scientific manner. Vincent and Baswitz have devised processes for obtaining ammonia, methyl alcohol, and amino-compounds, and Ortlieb and Müller for recovering the nitrogen in the form of methylamine or hydrocyanic acid from these waste products. The first process to be successful on a commercial scale was worked out by Reichardt and Bueb. It consists in passing the gases obtained by the dry distillation of the residuary molasses into a series of firebrick pipes heated to a bright red temperature, whereby practically all the nitrogen becomes transformed into the form of ammonium cyanide.

This process has recently undergone considerable development, and large plants have been installed at Dessau and Hildesheim. The molasses is carbonized at a temperature of about 400° C., and a residue is obtained having a potash-content of about 60 per cent. The gases are drawn into a zigzag series of pipes constructed of firebrick, and kept there for 15 seconds at a temperature of 1000-1100° C. They next pass into a condenser where the ammonia and tar are separated, and where they are washed with sulphuric acid. They then pass through a cyanide scrubber in which a solution of hydrocyanic acid is

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formed, and are finally drawn into a fan and forced into the ovens to be subsequently used for heating up the firebrick pipes.

The ammonium sulphate liquor is concentrated, and allowed to crystallize. The cyanide solution is distilled with sulphuric acid, and the hydrocyanic acid absorbed by caustic soda liquor, from which by evaporating, crystallizing, and centrifugalling, solid sodium cyanide is obtained. This is further purified by melting in iron vessels, and filtering the fused mass. The production of sodium cyanide, it is stated, amounts to 3500-4000 kilos per day.

The large quantities of tar accumulating from this process is, in comparison with ordinary coal-tar, an almost valueless product. It finds but a limited application as a binding material in the manufacture of briquettes. In the present paper the author describes his investigations on the nature of this tar, and its behaviour on being distilled alone and with certain reagents. The following is a summary of his results:—

Nature of the tar.—In appearance it is a brownish-black, thick, unpleasant-smelling substance, from which, on standing, a watery liquid smelling strongly of ammonia separates. The tar was found to contain 0·35 per cent. of ash, and to leave, after drying at 105° C., a residue amounting to 88·2 per cent. The neutral oily matters extracted by benzene were 50 per cent., and resinous substances soluble in alcohol, but insoluble in benzene, 11 per cent.

Direct distillation of the tar.—The fraction of the distillate coming over below 120° C. consisted of water and a greenish-yellow oil; the fractions from 120–125° C. were brownish-yellow oily products with a dark green fluorescence. All the fractions were strongly alkaline in reaction. The compounds of definite composition that were identified were ammonium carbonate, and acetone; the quantity of the latter was found to be 0·02 per cent. on the tar.

Distillation after addition of concentrated sulphuric acid.—The fraction below 120° C. consisted, as before, of water and a greenish-yellow oil; it gave, however, an acid reaction. Those fractions from 120–160° C. were yellow to brown oils, without fluorescence, and alkaline in reaction. The compounds identified were hydrocyanic acid, acetone, ammonium sulphide, and sulphuretted hydrogen.

Distillation after the addition of solid caustic soda.—Again, the fraction below 120° C. was the same as in the first distillation; those from 120–225° C. consisted of oily products of brownish-yellow colour and had a green fluorescence. Considerable amounts of ammonia were evolved below 140° C., and all the fractions were strongly alkaline in reaction. Ammonium carbonate, ammonia, and acetone were identified in the distillate.

Treatment of the tar with caustic soda solution.—(*a*) The residue obtained on treating the tar with caustic soda solution contained basic

and neutral bodies. It was treated with dilute sulphuric acid and the solution was distilled in steam: the distillate contained traces of hydrocyanic acid. The residue from the distillation was rendered alkaline and again distilled in steam: pyridine bases to the amount of 0·3 per cent. on the tar were obtained in the distillate. (*b*) The solution resulting from the treatment of the tar with caustic soda solution contained acid and phenolic bodies; to remove volatile and non-phenolic bodies, it was distilled in steam: an ammoniacal distillate with traces of a greenish-yellow oil was obtained. The residue from the distillation was saturated with carbon dioxide to separate the phenolic bodies, and again distilled in steam. The distillate had a strong smell of creasote. The amount of creasote oils was found to be 0·3 per cent. on the tar. The pyridine bases and creasote oils, it is pointed out by the author in conclusion, are of interest for they are probably present in sufficient quantity to make the tar a utilizable product.

Molasses as Stock Food. *S. Weiser and A. Zaitschek. Landw. Jahrbuch, 37, 130-149*, through *Chem. Centr., 1908, 9, 881-882.*

The authors have conducted a number of experiments, extending over a considerable period of time, with the object of ascertaining to what extent in the feeding of cattle it is possible to increase the amount of molasses in a stock food rich in nitrogenous matters without limiting its albumenoid saving properties. They further endeavoured to determine the greatest possible amount of molasses which, in the feeding of heavy draught horses, could advantageously replace a concentrated stock food.

Their conclusions are as follows: the albumenoid saving properties of molasses depend principally on its carbohydrate-content, although it is possible the amides contained in the molasses play a part in cattle feeding. 8 kilos. of molasses per 1000 kilos. of live weight of animal fed were used with most satisfactory results, against 6 kilos. which has been stated to be the maximum. For hard-working draught horses molasses was proved to be an exceedingly wholesome food. Horses which were fed on 2·3 kilos. of molasses, 3·2 kilos. of bran, 3·25 kilos. maize and hay *ad lib.* were, in spite of the severe work they underwent, in the best condition at the end of a trial of several months. 4·0 kilos. of molasses per 1000 kilos. live weight were readily taken; on increasing the quantity to 5·5 kilos. it was found the condition and capacity of the animal for work were in no way influenced, the only objection to the larger quantity being the sticky condition of the molasses mixture thus produced.

Estimation of the Dry Substance in Sugar-house Products by the Abbe Refractometer. *A. E. Lange. Zeit. Ver. deut. Zuckerind., 1908, 177–198.*

The conclusions drawn from a number of experiments carried out at the "Institute für Zucker-industrie" and in certain raw sugar factories and refineries, under the direction of the author, are summarised as follows:—

(1) The determination of the dry substance content of sugar juices is more readily carried out by means of the Abbe refractometer than by the use of the Mohr-Westphal balance or by means of a spindle. The instrument is easy and convenient to manipulate.

(2) A large number of observations showed that the determination of the dry substance in sugar-house products by the refractometer gave higher values than those obtained by dessication, but that they were lower than those obtained from the Brix degrees.

(3) When working with impure and dark coloured products of the factory, clarification is necessary. For molasses, a 50 per cent. solution should be used, and a little lead acetate, 2-3 cc. per 50 grm. of molasses, added; for beet juices and diffusion juices, 10 cc. of lead acetate, and 0·25 cc. of 10 per cent. acetic acid may be used. An increase of defecating material over the amounts stated, influences the results.

(4) For greater convenience in sugar work, the instrument should be provided with an accurate percentage scale.

(5) For the illumination of the refractometer, it is best to use a source of light, other than daylight, as constant as possible in intensity and colour.

Estimation of the Acidity of Soils. *H. Süchting. Zeit. Angew. Chem., 1908, 21, 151-153.*

In the proposed process, which is a modification of Tacke's (see *Chem. Zeit., 1897, 21, 174*), the amount of carbon dioxide liberated by the acids of the soil from calcium carbonate, is estimated. 10-50 grms. of the sample are placed in a flask of about 300 cc. capacity, and about 150 cc. of recently boiled, distilled water are added. A known weight of pure calcium carbonate (about 0·4 grm.) is transferred to the flask; the liberated carbon dioxide is expelled from the apparatus by a current of hydrogen, and collected in a receiver containing standard alkali. After about two hours the contents of the receiver are titrated against standard acid. 50 cc. of 20 per cent. hydrochloric are then introduced into the flask, and the carbon dioxide from the undecomposed carbonate determined as before.

The difference between the amount of carbon dioxide theoretically obtainable from the amount of calcium carbonate used, and that

found by the latter titration, gives the quantity liberated by the acids of the soil. In an example given by the author, 50 grms. of soil and 0·4 of $CaCO_3$ were used; the undecomposed carbonate remaining after neutralization of the soil acids was found by titration to be 0·1244 grm.; theoretically, 0·4 grm. $CaCO_3$ yields 0·1740 grm. of CO_2. Then the CO_2 liberated by the acids of the soil was 0·1740 — 0·1244 = 0·0496 grm. = 0·099 per cent.

Generally, the first titration may be dispensed with; if, however, the sum of the amounts of carbon dioxide found by the two titrations is greater than that obtainable from the calcium carbonate added, carbon dioxide has been formed by the decomposition of substances in the soil, and a deduction must be made for the amount in excess.

DETERMINATION OF FREE ACID IN SUPERPHOSPHATES. *Van Dormal. Bull. Assoc. Chim., 1908, 25, 885.*

A modification of Bohle's method (this Jl., 1908, 202) is proposed. 5 grms. of the dried sample are agitated with 100 cc. of ether, and allowed to stand in contact with the solvent for 3 hours. The free acid is then estimated by means of standard alkali, using methyl orange as indicator.

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. THOMPSON, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; and 322, High Holborn, London.

ENGLISH.—APPLICATION.

5501. J. J. EASTICK, London. *Improvements in the purification of sugar.* 11th March, 1908.

ABRIDGMENT.

10196. J. W. MACFARLANE, Cathcart, Co. Renfrew, N.B. *Improvements in apparatus for the treatment of sugar in the centrifugal drying machine.* 2nd May, 1907. This invention relates to an apparatus for the treatment of sugar in a centrifugal drying machine, the arrangement of a cover for the machine casing consisting of two approximately semi-circular parts arranged to slide in guides inclined to each other in such manner that if the guides were produced they would meet together at a point in front of the outer casing.

GERMAN.—ABRIDGMENTS.

193112. GÖSTA EKSTRÖM, of Limhamn, Sweden. *A process for making glucose or ethyl alcohol from substances containing cellulose.* 17th January, 1906. This process for extracting grape sugar or ethyl alcohol from substances which contain cellulose, such as ordinary

wood shavings, sawdust, peat, moss, straw, or other like substances, consists in the cellulose being first converted into acid cellulose by means of concentrated mineral acid at the ordinary temperature and at atmospheric pressure, which acid cellulose is then converted into grape sugar after being separated by dilution with water and the separation from the acid by boiling with dilute mineral acid at a somewhat higher than atmosphere pressure.

193600. CARL STEFFEN, of Vienna. *A method for obtaining crude juice and nutritive pressed residuals containing sugar from sugar beet or other sacchariferous plants.* 5th January, 1902. This process in which the sugar beet or other sacchariferous plants, which are heated in the form of slices with highly heated raw juice to at least 66° C. and afterwards freed from juice by being pressed, is characterized by the sections heated in the extraction process being directly subjected without disintegration before the recovery of the juice by expression, to temperatures of from 66-100° (preferably 85° C.) to a removal of the juice by extraction in diffusers, which leaves the sugar contents of the vegetable sections above 3½ per cent.

194046. Dr. HERMANN CLAASSEN, of Dormagen. *A process for the recovery of the drain water in diffusion.* 13th December, 1905. This invention relates to a method of re-utilizing all the waste water from the diffusion process and recovering the dry substance and the sugar contained therein by reconveying the waste water which has been freed from particles of shreddings and which is intermixed with the necessary fresh water into the diffusion apparatus and consists in the finest particles of the shreddings, which are not retained by the sieve and which are formed by the disintegration and breaking up of the pith of the roots, being accumulated by the unclarified waste water being repeatedly returned to the diffusion battery each time on the shreddings of the last diffuser until an observable diminution of the pressure is noticed, whereupon the drain of the respective diffuser is caught separately, clarified by deposition, and returned to the diffusion, whilst the small quantity of liquid which contains sludge is discharged or again clarified. In a modification of the process hereinbefore set forth, the depositions of the fine particles of the shreddings is accelerated by the addition of small quantities of an indifferent fine granular substance, such, for instance, as moist sludge from the press, which is of higher specific gravity.

194235. EUDO MONTI, of Turin, Italy. *Process and apparatus for concentrating solutions, more particularly sugar juice, by means of freezing and compression.* 8th September, 1905. This process is characterized by the freezing being operated by means of tubular coils arranged in pairs lying one above the other in the freezing vessel and standing at equal distances apart, and by the cooling medium circulating in these coils being alternately moved forward from the

periphery of the freezing vessel towards its centre and *vice versa*, in order that layers of ice of uniform permeability are formed. A freezing vessel for carrying out the said process consists of a vat in which at various points of its height different independent spiral tubes are arranged, the coils of which run alternately from the periphery towards the centre.

194240. HEINRICH JÜRGENS, of Fraustadt. *A circulation arrangement having inclined rebounding surfaces for saturation pans and like apparatus.* 3rd November, 1906. In this circulation arrangement the gas inlets are distributed in large numbers over the bottom and the apparatus is characterized by rebounding plates being arranged beneath and above the level of the stationary juice, inclined in such a way to one another that by the lateral deflection of the gas jets a mixture of liquid and gas shooting up above the level of the liquid when at rest is produced and is forced to take its course through the part of the vessel, which is not filled with liquid, towards the opposite side.

194809. GUSTAV ADT, of Forbach, Lorraine. *A centrifugal having an insertion of sieve form and suitably shaped.* 20th March, 1906. The chief feature of this centrifugal consists in the operating shaft of the drum being formed of a tube which connects the inner chamber of the case and the insertion with a suction device and is obliquely adjustable on a vertical axis.

NOTE.—Copies of all published specifications with their drawings in these lists can be obtained from W. P. Thompson & Co., 6, Lord Street, Liverpool, at One Shilling a copy for English or American Patents, and Two Shillings for German. In ordering please give number and date.

Patentees of Inventions connected with the production, manufacture and refining of sugar will find *The International Sugar Journal* the best medium for their advertisements.

The International Sugar Journal has a wide circulation among planters and manufacturers in all sugar-producing countries, as well as among refiners, merchants, commission agents, and brokers, interested in the trade, at home and abroad.

The Natal sugar industry cultivates an area of about 45,000 acres, and employs some 200 Europeans and nearly 10,000 Indians and natives.

Some sixty Hindoos, supposed to have come from Vancouver, were recently shipped from San Francisco to Honolulu to work on the sugar plantations out there.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of March, 1907 and 1908.

IMPORTS.

Raw Sugars.	Quantities. 1907. Cwts.	Quantities. 1908. Cwts.	Values. 1907. £	Values. 1908. £
Germany	2,249,950	1,975,592	1,017,467	996,999
Holland	55,917	79,778	23,437	38,881
Belgium	110,268	39,489	46,609	18,579
France	40,023	48,186	20,713	27,228
Austria-Hungary	234,988	242,545	105,767	123,384
Java	64,194	168,064	33,230	87,555
Philippine Islands	19,569	....	8,500	....
Cuba	....	....	....	....
Peru	100,996	292,830	45,352	152,891
Brazil	180,369	1,612	74,439	728
Argentine Republic	....	....	....	....
Mauritius	125,322	132,405	52,278	59,963
British East Indies	....	20,491	..	8,368
Straits Settlements	40,143	49,859	17,665	22,033
Br. W. Indies, Guiana, &c.	391,156	273,746	226,264	187,878
Other Countries	221,723	161,215	108,697	86,407
Total Raw Sugars	3,834,618	3,485,812	1,780,418	1,810,894
Refined Sugars.				
Germany	2,666,545	3,165,212	1,550,634	1,941,791
Holland	719,933	674,005	445,592	442,642
Belgium	68,498	55,859	41,776	34,827
France	468,678	320,197	269,379	200,548
Other Countries	155	8,667	190	5,392
Total Refined Sugars	3,923,809	4,223,940	2,307,571	2,625,200
Molasses	656,684	662,904	130,472	127,251
Total Imports	8,415,111	8,372,656	4,218,461	4,563,345

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	178	524	116	208
Norway	4,022	2,222	2,359	1,409
Denmark	21,810	21,562	11,250	11,977
Holland	18,627	17,121	12,138	11,952
Belgium	2,670	1,970	1,572	1,331
Portugal, Azores, &c.	8,591	3,675	4,679	2,172
Italy	5,959	2,658	3,108	1,539
Other Countries	75,835	48,228	55,867	36,909
	137,692	97,960	91,089	67,497
Foreign & Colonial Sugars				
Refined and Candy	2,827	3,354	2,142	2,555
Unrefined	11,421	17,410	6,469	10,756
Molasses	1,433	233	376	74
Total Exports	153,373	118,957	100,076	80,882

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1908. Tons.		1907. Tons.
Total Receipts Jan. 1st to April 16th ..	592,734	..	654,486
Receipts of Refined ,, ,, ...	510	..	355
Deliveries ,, ,, ...	597,881	..	625,048
Importers' Stocks, April 15th	473	..	29,438
Total Stocks, April 29th	264,000	..	319,990
Stocks in Cuba, ,, ...	203,000	..	428,000
	1907.		1906.
Total Consumption for twelve months..	2,993,979	..	2,864,013

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1907 AND 1908.

(Tons of 2,240lbs.)	1907. Tons.		1908. Tons.
Exports	554,760	..	404,173
Stocks	449,932	..	253,292
	1,004,692	..	657,465
Local Consumption (3 months)	12,500	..	14,940
	1,017,192	..	672,405
Stock on 1st January (old crop)	....	..	9,318
Receipts at Ports up to March 31st	1,017,192	..	663,087

Havana, March 31st, 1908. J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR THREE MONTHS, ENDING MARCH 31ST, 1908.

SUGAR.	Imports. 1906. Tons.		Imports. 1907. Tons.		Imports. 1908. Tons.	Exports (Foreign). 1906. Tons.		Exports (Foreign). 1907. Tons.		Exports (Foreign). 1908. Tons.
Refined	196,520	..	196,190	..	211,197	167	..	141	..	168
Raw	218,880	..	191,731	..	174,291	2,627	..	571	..	871
Molasses	33,147	..	32,834	..	33,145	235	..	72	..	12
Total..........	448,547	..	420,755	..	418,633	3,029	..	784	..	1,051

HOME CONSUMPTION.

	1906. Tons.		1907. Tons.		1908. Tons.
Refined..	188,572	..	184,109	..	204,578
Refined (in Bond) in the United Kingdom	140,224	..	119,542	..	130,089
Raw	30,473	..	19,405	..	26,236
Molasses	31,739	..	28,432	..	35,869
Molasses, manufactured (in Bond) in U.K.	18,039	..	18,951	..	20,012
Total..................................	409,047	..	370,439	..	416,784
Less Exports of British Refined....................	11,026	..	6,885	..	4,898
Total Home Consumption of Sugar	398,021	..	363,554	..	411,886

Stocks of Sugar in Europe at uneven dates, April 1st to 25th, compared with previous Years.

In thousands of tons, to the nearest thousand.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	Total 1908.
167	1086	509	761	180	2704

	1907.		1906.		1905.		1904.
Totals	2823	..	3123	..	2191	..	2841

Twelve Months' Consumption of Sugar in Europe for Three Years, ending March 31st, in thousands of tons.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria-Hungary	Holland, Belgium, &c.	Total 1907-08.	Total 1906-07.	Total 1905-06.
1907	1173	650	548	201	4179	4439	3948

Estimated Crop of Beetroot Sugar on the Continent of Europe for the current Campaign, compared with the actual crop of the three previous Campaigns.

(From Licht's Monthly Circular.)

	1907-1908. Tons.	1906-1907. Tons.	1905-1906. Tons.	1904-1905. Tons.
Germany	2,132,000	2,239,179	2,418,156	1,598,164
Austria	1,430,000	1,343,940	1,509,789	889,431
France	725,000	756,094	1,089,684	622,422
Russia	1,410,000	1,440,130	968,500	953,626
Belgium	235,000	282,804	328,770	176,466
Holland	175,000	181,417	207,189	136,551
Other Countries .	435,000	467,244	410,255	332,098
	6,542,000	6,710,808	6,932,343	4,708,758

THE

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☞ All communications to be addressed to the Editor, Office of "The Sugar Cane," Altrincham, near Manchester.

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NOTICE TO READERS.—If the Advertisement pages stick together, bang their edges on the table, when they should easily separate.

NOTES AND COMMENTS.

The Reduced Sugar Duty.

The sugar users will now be happy. Their claims of grievance against the sugar duty, introduced by the late Government with a view to broadening the basis of taxation, have been strong and persistent. Granting that their allegations of a ruined industry were in many cases exaggerated, there is no doubt that as a whole their trade was put to some severe restriction by this tax on one of their raw materials. They, however, most illogically included the Brussels Convention in their general condemnation and endeavoured to saddle it with results solely occasioned by the heavy excise duty. They have now obtained a measure of relief that ought to satisfy them, if indeed they are capable of being satisfied with anything else than sugar dumped down in this country at far less than the cost price, as in 1902. We hope they will agree, at least tacitly, that the *status quo* of that year cannot be expected to hold good save in very exceptional instances due to a combination of circumstances which, we trust, will seldom if ever re-occur. And we hope that the old cry that the Sugar Convention was costing them untold sums of money will not be heard again.

Precisely what led the Premier (the late Chancellor of the Exchequer) to decide on a reduction of the sugar duties is not apparent. The arguments used by him in his introductory speech are all very well, but the Treasury does not lightly throw away what is admittedly a considerable source of income without obtaining some *quid pro quo*, and the new scheme of old age pensions will involve the expenditure of a very large sum of money which will have to be provided for in next year's Budget. There were not wanting suggestions that it was a diplomatic move to further the success of Mr. Winston Churchill's candidature in the by-election occurring in Dundee, the marmalade town. Whether this was so or not, there is no doubt that the announcement, coming just before the polling day at Dundee, was calculated to help the already once defeated Cabinet Minister to secure what proved a satisfactory majority and ensure his return to the Board of Trade, to which office he had just been appointed.

Anyhow, the sugar duty is now very considerably reduced from 4s. 2d. to 1s. 10d. per cwt. above 98 Pol.; and we hope it may not be found necessary to alter it again till at least the time comes when the powers that be are disposed to differentiate between British and foreign sugar, and the duty is changed from a mere excise into a preferential import tax.

The Brussels Sugar Commission.

A special session of the Brussels Sugar Commission was convoked on March 26th last at the request of the Italian Government. In accordance with the articles of the Convention Italy has so far been at liberty, whilst remaining a contracting State, to give sugar bounties and to maintain a surtax in excess of that laid down by the Convention, on the condition that she did not become an exporting country. The object of this meeting of the Commission was to consider the request of the Italian Government to be allowed to vary those conditions to the extent of exporting a maximum of 15,000 tons per annum. From the outset, however, it was manifest that the Italian request would not obtain the necessary favourable unanimity amongst the members of the Commission, though the British delegate was in favour of granting it. It was pointed out with some force that it was a proposal to alter the terms of the Convention, and that it would thus affect the settlement arrived at under the Additional Act and Protocol. As a consequence the majority of the Commission, while expressing a desire that Italy should remain in the Union, were unable to consent to Italy becoming an exporting country even within limits. The general view of the Commission was however voiced in a declaration made by the German delegates to the effect that they were "convinced that the Permanent Commission, in the event of its having to decide whether Italy continues to conform with the special condition laid down in Article VI. of the Convention, would consider the question,

as far as possible, and in accordance with the principles of the Convention, in a friendly spirit." This implied that the rule laid down at the 1901-02 Conference that trifling and accidental exportations would not count was to be made a basis for any future negotiation. The Italian delegate, however, reserved entirely the right of his Government to take whatever course they judged best, and it remains to be seen whether Italy will decide to retire from the Union or not. So far no statement has been forthcoming of her intentions, and she is allowed another month (till July 1st) to come to a decision.

Dr. Herzfeld's Jubilee.

On April 27th last the Institute of the Sugar Industry in Berlin was filled with a representative body of sugar manufacturers from all over Germany, who had assembled to honour Professor Dr. A. Herzfeld, on the occasion of the 25th anniversary of that gentleman's connexion with the Institute as its Director. Complimentary speeches were made by Dr. Preissler and Prof. von Lippmann, and the latter announced that a special fund had been started, to be called the "Herzfeld Foundation," with the object of helping financially any chemists or sugar technicists who were in need of assistance. Subscriptions to the extent of 20,000 mks had already been promised. Professor Herzfeld was then presented with a fine work of art and an artistically illuminated diploma; and the day's proceedings terminated with a banquet.

Consular Reports.

It has been a long-standing complaint that the British Consular Service is, to put it mildly, far from efficient, and that the qualifications of the officials from a business standpoint are in many cases practically nil. The reform of the service has yet to be accomplished, but something has already been done to make the official Reports more thorough; and with that object the editing of these publications has lately been undertaken jointly by the Board of Trade and the Foreign Office, instead of by the latter Department only as of yore. A very welcome feature, just introduced, is the inclusion of excellent sketch maps, prepared by the Ordnance Survey, of the country or district reported on. Amongst those lately issued, mention may be made of very clear maps of the Hawaiian Islands and of Java, in which all the chief towns and lines of communication are shown. Commercial men dealing with such districts will appreciate the opportunity of making themselves familiar with the geography of their customers' country, and of at least being able to ascertain whether a given town be on the sea coast or miles inland. It is however still a defect of these Consular Reports that the generally excellent list of Contents often only gives details with regard to the chief Consular District, and when, as is frequently the

case, several other Districts find space in the Report, a single line only denotes them in the Contents page. But as one or other of them often contains a long account of some special industry, it is surely incumbent on the compilers of the Report to see that the same detail of indexing is given to them as is the case with the chief District, which gives its name to the Report in question. We trust that the authorities will give their attention to this matter, as, if an index is to be of any use to a busy man, it must be complete.

Swedish Sugar Duties.

Some alteration in the Swedish excise and import duties on sugar is forecasted in the *Board of Trade Journal*, from official information to hand. At the present time excise duty at the rate of 13 öre per kilog. is levied on all sugar brought to market, whether imported or of home production. From the 1st January, 1909, until the 31st December, 1911, excise duty is to be levied at the rate of 15 öre per kilog.; from 1st January, 1912, to 31st December, 1912, at the rate of 15½ öre per kilog.; and from 1st January, 1913, at the rate of 16 öre per kilog. Simultaneously with the increase of the excise duty on both home-produced and imported sugar, the Customs duties which are levied in addition on imported sugar are to be reduced as shown in the subjoined statement:—

	Present Rate of Import Duty.	Rate of Import Duty. From 1st Jan., 1909, to 31st Dec., 1911.	From 1st Jan., 1912, to 31st Dec., 1912.	From 1st Jan., 1913.
	Kr. öre. Per Kilog.	Kr. öre. Per Kilog.	Kr. öre. Per Kilog.	Kr. öre. Per Kilog.
Unrefined sugar up to No. 18, Dutch standard	0 11¾	0 10	0 09½	0 09
Unrefined sugar, No. 18, Dutch standard and above; refined sugar, including candy, loaf, and powdered sugar	0 17	0 15	0 14½	0 14

Paper Pulp from Megass.

A good deal of attention has been given in the daily press to the news to hand from Trinidad that Mr. Bert de Lamarre, one of the leading planters, had succeeded, after two years' experiments, in producing excellent paper from cane megass, estimated to be worth £5 per ton. Mr. de Lamarre is further reported to have expended £17,000 in erecting a paper pulp works to deal with the megass produced in his sugar factory. This plant has a capacity of 15 tons per day, and is run by waste steam from the factory. It is proposed, when megass is not available, to keep the pulp mill going with Para grass, banana refuse, and other fibrous materials.

We must remark that, to begin with, the idea of making paper from megass is by no means new; some years ago we chronicled the fact that a Louisiana factory was turning out brown packing paper made from cane fibre. Apparently, however, the venture was not so profitable as to warrant its rapid extension. It will, therefore, be of interest to learn whether the Trinidad process is likely to meet with better success; we should certainly like to have the opportunity of examining samples of the new paper. No details of its nature beyond the price per ton have been vouchsafed so far, and we are quite in the dark as to whether it is a fine bleached paper or a coarse packing quality which is made from the diverse raw materials cited above, and it is also not quite clear whether the paper is made on the spot or only the paper pulp. We hope more detailed particulars will soon be available. In using the megass, it should not be forgotten that it has hitherto been used as the principal fuel of the sugar factory, and if now retained as a raw material for other industries, fresh fuel will have to be found to take its place.

RUSSIA, THE MARKET, AND THE CONVENTION.

The stock of free sugar in Russia was, on the 1st September last, 239,693 tons. On the 1st April this stock had increased to 595,369 tons. This is a very heavy weight round the neck of the Russian sugar industry. The *Prager Zuckermarkt* says that the manufacturers are having a very bad time, owing to the excessive production of the last two years, the stationary condition of the consumption, and the consequent fall in the price of sugar. On the top of this comes the scarcity of money and the want of credit. Matters have reached a crisis, many firms are insolvent, and the loss to the banks has been heavy.

If these reports are well founded it is quite possible that a large portion of the excessive stock may be forced on our markets next September with considerable precipitation. This white sugar cannot go to the United States, the place where sugar will be most wanted at that time. Nor will any of our Continental neighbours permit it to enter their markets. There is, therefore, every prospect of a glut of inferior white sugar on our markets in the autumn. The opponents of the Convention will cry out "See what you have been shutting out all this time!" The cry will not be true, because up to last year Russia had no surplus to spare for us; but it will be believed, just as the cry of dear sugar was accepted in 1904-5, though the dearness arose entirely from the sudden disappearance of 1,200,000 tons from the estimated supplies for the year.

The Russian industry is now reducing its sowings, but the mischief has been done; excessive production, stimulated by a vicious system, has brought the inevitable results—"glut, collapse, and ruin." It is a

pity, because the Russian sugar industry is a most important element in the agricultural prosperity of a very large portion of that vast country. The *Journal des Fabricants de Sucre* of 20th May gives a most interesting and instructive abstract of a recent essay, published in 1907 by the Society of Sugar Manufacturers of Kieff, entitled "The Sugar Industry in the Economic and Financial Life of Russia." The author is M. J. Zechanowsky, of St. Petersburg, an expert of the highest standing. There is no doubt, after examining his figures, that the legislation of 1895 gave a powerful stimulus to the production, and is responsible for the present crisis. We have, in former articles, described the nature of this stimulus and the simple method by which it might be moderated, and we need not revert to that part of the subject. But it is interesting to see, from the figures now given to us, the sudden leap taken by the industry after the legislation of 1895. During the ten years preceding that date the extent of land cultivated with sugar beet remained almost stationary, the increase being only from 299,000 to 307,000 déciatines. But from 1895 the increase of land cultivated was rapid and considerable. While in the preceding decade the extent of land had remained stationary, the number of factories had actually decreased from 241 to 227. From 1895 to 1905 the number of factories increased from 227 to 278, and the extent of land cultivated increased from 321,000 déciatines in 1895-6 to 530,000 déciatines in 1902-3. At that date the artificial stimulus was reduced and the quantity of land cultivated fell to 431,000 déciatines in 1904-5.

M. Zechanowsky appears to ascribe this reduction to excessive stocks. We venture to think that he is mistaken on this point. He goes on to declare that the excessive stocks of former years have now been entirely got rid of, and that the industry has returned to its normal state and will develop with more intensity than ever "so long as the legislation in force combines all the necessary conditions."

A stock of 600,000 tons, a crisis, many failures, and great losses to bankers, are the reply to his hopeful forecast.

As we have urged on former occasions, if the Convention had not been tampered with, and its mainspring removed, it would have furnished the remedy for these evils. The Russian Government would have seen the error of their ways, would have removed the artificial stimulus, would have properly qualified for their entry into the Convention, and there would have been an end for ever to the Russian sugar bounty. Free Trade in sugar would have been restored throughout the world. But the great so-called Free Trade party would not have it so. They prefer that Russian sugar producers shall still remain in the happy position of being protected in British markets.

REDUCTION IN THE SUGAR DUTY.

The Liberal Government's third Budget proposals were made public on May 7th, and contrary to expectations Mr. Asquith announced a substantial reduction in the duties levied on sugar. His decision was all the more unexpected inasmuch as the scheme of old age pensions foreshadowed for some time was expected to prove a drain on the Treasury that would forbid any reduction in existing taxation. However, the Premier decided to forego a large part of the sugar tax, and to leave to his successors the task of finding the money required for old age pensions.

The following report of Mr. Asquith's speech is taken from the *Times* :—

Reduction of the Sugar Tax.

There is one impost in particular to which, as my declarations in the past will have prepared the Committee to believe, my colleagues and myself have felt compelled to give special attention. I refer to the sugar duty. The sugar duty is one of those experiments in indirect taxation which were introduced by Sir M. Hicks Beach, primarily, no doubt, to meet the expenses of the war, but which were regarded by him as permanent additions to our fiscal system. That was in the pre-tariff reform days. When we look back upon those experiments, however, we find that neither the corn tax nor the coal tax survived for long, and the sugar tax was, I think, almost universally regarded—quite as much, I believe, by the occupants of the benches opposite as by any one else, judging from their public declarations—as sooner or later doomed to the same fate. The truth is that a sugar duty is one of the most objectionable of all our indirect taxes, because it is at one and the same time a tax upon food and a tax upon raw ,material. Unfortunately, it is very productive. Last year it brought in £6,700,000. You will see in a moment that the resources at my disposal do not enable me to propose its immediate and total abolition. I am compelled to stand in a white sheet, but I do not think I am quite such a bad offender as some hon. gentlemen may think. Undoubtedly I have on previous occasions expressed doubts whether a partial remission of the sugar tax, although I have always said it would be a great boon to manufacturers who use sugar as a raw material, would reach the ordinary consumer in the shape of a measurable reduction in the retail price. I also expressed a doubt, that subsequent investigation showed to be ill-founded, as to whether a reduction of a farthing would actually operate upon retail prices. I am satisfied that it would. I do not think it would in the case of tea, but in the case of sugar I think it would. Every Chancellor of the Exchequer has to learn something. Although I was wrong in saying that a partial remission of the sugar tax, although it would benefit the manufacturer, would not be brought home to the consumer, the difficulties are very considerable. This Customs duty upon imported sugar is 4s. 2d. per cwt. The popular idea is that the rate of duty is a halfpenny per lb. In point of fact it is 100 halfpennies upon 112lb. of sugar. The figure is not a halfpenny per lb., but nine-tenths of a halfpenny per lb. The rate was fixed for a good, or at any rate plausible, reason. When Sir M. Hicks

Beach imposed the duty in 1901 it was extremely important for him to conciliate the trade, and in order to make the thing work smoothly, and also, no doubt, to compensate the trade for the new restrictions which it had to undergo, he said that while the burden to the consumer would no doubt be at the rate of a full halfpenny in the pound, he would charge the importer, not 4s. 8d., but only 4s. 2d. per cwt., leaving him 6d. to compensate him for all the incidental drawbacks and disadvantages of the new state of things. The Committee will see that the moment you realize that the rate is not a full two farthings but only one farthing and a fraction of another, the practical problem not of abolishing altogether but reducing the tax is one of considerable complexity. There are three ways in which it can be done. The first is to halve the duty as it stands. That, I think, is an objectionable way, and I have very great doubt whether, if you adopted that course, the halfpenny would actually go to the consumer. A considerable amount would go to him in time, but I think there would be considerable delay before he got the full benefit. Another way of dealing with the matter would be to reduce the duty to one farthing per lb., giving the consumer the benefit of the four-fifths of the farthing, which represents the difference between one farthing and the total duty now. That would be much the cheapest way. There again I very much doubt whether the consumer would reap the real benefit. The third course, the course the Government proposes to adopt, is this—the least expensive and the most effective—to reduce the duty by one farthing, not to one farthing, so that the Exchequer would retain only the benefit of the odd four-fifths of a farthing which remains. If you do that you give the consumer an irresistible claim to the benefit; it is the only way in which I believe that that result can be absolutely attained. We propose to reduce the duty of 4s. 2d. per cwt. to 1s. 10d. We propose that that reduction, as far as raw and refined sugar is concerned, should take effect as from May 18, and on drawbacks at the same date. On articles manufactured, of which there is no doubt a considerable quantity in stock, it is only fair to give the persons concerned longer notice; and we therefore propose that the reduction, as far as they are concerned, shall not take effect till July 1.

This reduction in the duty was welcomed by the sugar dealing and sugar using trades; but there was a good deal of discontent occasioned by the Premier's decision to bring the new scale of duties into force within 10 days. It was asserted that large stocks of sugar which had been taken out of bond at the old rate could not be disposed of within that short interval, and that the traders would in consequence lose the difference in the duties. The Chancellor of the Exchequer received several deputations on the subject, but remained obdurate, asserting that those same dealers who now stood in fear of loss, must have made a large profit on their stocks when the duty was imposed, and having regard to this and to the fact that they would benefit generally by the reduction in the rate, he saw no reason to depart from the plan originally arrived at. The change therefore took place on May 18.

As to the effects of this reduction, there is no doubt the sugar users will greatly benefit by the change; it was mainly their trade

that suffered from the sugar duties as originally imposed, and they should have no difficulty now in carrying on their business profitably. The benefit to the consumer will also not be inappreciable, and by making sugar cheaper it is reasonable to suppose the consumption will increase to the advantage of the sugar manufacturers and refiners. As however, the new rates are based as before on the polarization of the sugar, it is hardly to be anticipated that any preference will be gained by any section of the sugar manufacturing trade that they did not already possess.

Below we give a list of the new rates, for the compilation of which we are mainly indebted to the *West India Committee's Circular*.

Articles.	Rates of Duty.	s.	d.
Glucose, solid	the cwt.	1	2
,, liquid	,,	0	10
Molasses and invert sugar and all other sugar and extracts from sugar which cannot be completely tested by the polariscope, and on which duty is not otherwise charged:—			
If containing 70 per cent. or more of sweetening matter	,,	1	2
If containing less than 70 per cent. or more of sweetening matter	,,	0	10
If containing not more than 50 per cent. of sweetening matter	,,	0	5
Saccharin and mixtures containing saccharin, or other substances of like nature or use	the oz.	0	7

Import Duties.	Old Rate. s.	d.	New Rate. s.	d.
Sugar:—				
Not exceeding 76 degrees of polarization ..	2	0	0	10
Exceeding 76 and not exceeding 77	2	0·8	0	10·9
,, 77 ,, ,, 78	2	1·6	0	11·2
,, 78 ,, ,, 79	2	2·4	0	11·6
,, 79 ,, ,, 80 . ..	2	3·2	0	11·9
,, 80 ,, ,, 81	2	4	1	0·3
,, 81 ,, ,, 82	2	4·8	1	0·6
,, 82 ,, ,, 83	2	5·6	1	1
,, 83 ,, ,, 84 .. .	2	6·5	1	1·4
,, 84 ,, ,, 85	2	7·4	1	1·8
,, 85 ,, ,, 86	2	8·3	1	2·2
,, 86 ,, ,, 87	2	9·2	1	2·6
,, 87 ,, ,, 88	2	10·2	1	3
,, 88 ,, ,, 89	2	11·2	1	3·4
,, 89 ,, ,, 90 . ..	3	0·4	1	4
,, 90 ,, ,, 91	3	1·6	1	4·5
,, 91 ,, ,, 92	3	2·8	1	5
,, 92 ,, ,, 93	3	4	1	5·6

	Old rate. s.	d.	New rate. s.	d.
Exceeding 93 and not exceeding 94	3	5·2 ..	1	6·1
,, 94 ,, ,, 95	3	6·4 ..	1	6·6
,, 95 ,, ,, 96	3	7·6 ..	1	7·1
,, 96 ,, ,, 97	3	8·8 ..	1	7·7
,, 97 ,, ,, 98	3	10 ..	1	8·2
,, 98 ,, ,, —	4	2 ..	1	10

CUSTOMS DRAWBACKS.

Molasses:—

Produced by a refiner in Great Britain or Ireland and delivered by him to a licensed distiller for use in the manufacture of spirits 0 5

Produced by a refiner in Great Britain or Ireland from sugar on which duty has been paid on importation, if the molasses is to be used solely for purposes of food for stock 0 5

Sugar:—

Sugar which has passed a refinery in Great Britain or Ireland, and on which the proper import duties have been paid—upon being exported, or deposited in any bonded warehouses for use as ships' stores or removed to the Isle of Man, a drawback equal to the duty on sugar of the like polarization.

FREE TRADE AND PROTECTION.

Mr. George Martineau, who is well known to our readers as a contributor to our columns for more than 20 years past, has taken advantage of the recent lull in the controversy over sugar economics to apply his well-proved principles to trade in general, and has availed himself of the existence of a miniature general election in our midst to plunge into the fray and try with his pen to convert some waverers to tariff reform. The following is one of his most characteristic letters and forms the fourth of a series he wrote to the *Manchester Guardian*, the leading Liberal newspaper in the north of England, which is largely read by Unionist Free Traders. We venture to reproduce it for our readers' benefit, believing it enunciates very clearly the principles which underlie Free Trade in its real sense, and shows, what has many a time been demonstrated in our columns, that Free Trade as we know it now is really Protection—for the foreigner, and that the application on our part of a simple defence against his attack comes nearer to being Free Trade than does the "Free Importation" principle of the Cobdenite:—

To the Editor of the Manchester Guardian.

Sir,—I have read Mr. Barrow's letter with the greatest pleasure. It helps me in making still clearer my arguments in favour of a Free Trade which is a reality, not a delusion.

The word Protection has in this connection two meanings, a natural and a conventional one. The conventional use of the word in books of political economy is to express the operation of keeping out foreign competition in order that the home industry may have a monopoly in its own markets. That is the Protection which is of the objectionable kind and which is resisted and denounced by all true Free-traders. Used in that sense the word is not well chosen, but it has become so habitually used that it must remain. Unfortunately this misuse of the word has given rise to many erroneous ideas, which have confused men's minds and greatly impeded the progress of Free Trade.

The natural meaning of the word Protection is defence. This is quite a different protection from the one just described; in many respects its opposite. If you bolster up an industry by shutting out all foreign competition it is called Protection. But that is something quite different from defending an industry against a deliberate attack upon it in its own markets by a State-aided foreign competitor. In the first case freedom of competition is destroyed by our own act, in the second by the State-aided foreign producer. Protection, so called, in the first case is injurious and wrong; in the second case protection, rightly so called, is not only desirable but absolutely necessary. In the second case a duty to counteract or ward off the foreign attack in order to restore freedom of competition is, in the words of a good, sound Free-trader, "not only consistent with Free Trade but positively conceived in the interest of Free Trade."

To take such action in the case of State-aided foreign competition is not, therefore, Protection in the sense in which the word has come to be used in a perfectly different and opposite case. Nor can it be correctly described as Retaliation, because warding off a blow is not retaliation.

As to the injury done to foreign industries by the system of big import duties, I have had exceptionally good opportunities of minutely examining the various effects of such policy, and as I have taken an active part in combating it in certain instances I can quite appreciate the reasons for deprecating such misguided schemes.

Lastly I come to the old outcry which always concludes any such discussion as we are now having. Beaten on the points of "Protection" and "Free Trade," my friendly opponents invariably fall back on the benefit derived by the consumer from obtaining goods below cost price. As your correspondent enthusiastically puts it, "we may welcome them as sunshine." Mr. Gladstone said exactly

the reverse. His eagle eye saw at once that the consumer was damnified, not benefited, by artificial cheapness, which must inevitably result in injured and crippled industries, reduced supplies, higher prices, and a steady march towards a foreign monopoly.

We are told in the letter to which I am replying that in certain cases of artificial State-aided competition "we can count on constancy of supply." Your correspondent is mistaken. Directly the market has been forced down by over-production below cost price the industry begins to suffer. The natural producer cannot, unless he is a millionaire, go on selling below the cost of production for very long. Reduced supplies, therefore, bring about a rise in price, and then the process repeats itself; but each swing of the pendulum brings us a step nearer to the monopoly of the market by the State-aided foreign producer. These are facts, not theories.—Yours, &c.,

GEORGE MARTINEAU.

Gomshall, Surrey, May 6th, 1908.

P.S.—Since writing this I have received the *Manchester Guardian* of May 5th and read your footnote to my second letter. It contains two points. To the first, that my original argument is "that the only real Free Trade is Protectionism," the foregoing is a sufficient reply. To the second, that my new argument is "that the only real way to buy cheap is to buy dear," I need only point out that the restoration of the natural price of a commodity by the removal of an artificial disturbance of that price is not correctly described as "buying dear." It is clearly to the interest of the consumer as well as of the producer that the natural price should be restored. That I have also demonstrated above.

[No amount of proofless reassertion, however confident, can make airy theories less airy. And we should be interested to hear the comments of a committee of housewives upon our correspondent's theory that if foreign sugar, say, were run up a penny a pound by an import duty, they could not be said to "buy it dear" but only to take part in "the restoration of the natural price of a commodity by the removal of an artificial disturbance of that price."—ED. "GUARD."]

We have included the comments of the Editor of the *Guardian* because they show to what straits Free-traders are reduced to defend their creed. The reference to a "committee of housewives" is really too ludicrous, and that the editor of a leading daily should be sanguine enough to suppose his readers would be hoodwinked by such stuff passes our comprehension. The housewife, it is almost needless to point out, chiefly considers the price *per se*, and can hardly be expected to understand all the intricacies of a problem which has required the close attention of an International Commission for years.

We think, however, the average housewife would have the sense to prefer paying the natural price for sugar if it would thereby guarantee her against ever paying more, and if she is old enough to remember what "more" was in 1889 and 1893, she will almost certainly vote for a continuation of natural prices. But it is quite a gratuitous assumption on the part of the Editor of the *Guardian* to suppose that any import duty levied on foreign sugar will amount to one penny per lb. This is equal to 9s. 4d. per cwt., or nearly four times as much as Protectionist countries participating in the Convention are allowed to levy on their sugar imports. Apart from that, the Editor is evidently entirely unconscious of the facts of the case. Taking his own instance of sugar, let us suppose that the Convention had remained as it was originally, but that a countervailing duty had been substituted for prohibition. Russia, the only important sugar producing country coming under the penal clause, would then be permitted to send her sugar to this country provided that she paid the countervailing duty. The world produces 12,000,000 tons of sugar; the total Russian exports to all countries average less than 200,000 tons. Can any sane person imagine that the price of sugar would be raised in this country by levying a countervailing duty on Russian sugar? The only object of levying a countervailing duty is to induce the offending State to remove the artificial advantage given to its industry. The prospect of having to pay a countervailing duty had already induced every European country except Russia to enter into the Convention, which not only compels them to abolish bounties but also fixes their import duty at such a low figure as to make it almost impossible for the industry to obtain such an artificial advantage from it as would amount to a bounty on export. But the Editor of the *Guardian*, like all those who pose as the champions of what they erroneously suppose to be Free Trade, cares for none of these things; they are beyond his ken. He is quite unaware that the mere prospect of a countervailing duty has restored free trade in sugar, by abolishing every artificial advantage which foreign producers previously enjoyed. The result would be the same with any other foreign industry making a similar attack.

In spite of the present depressed state of the British engineering trade, there are firms who are still busily employed, and among them may be cited Messrs. Holden and Brooke, of Manchester, who have been working overtime continuously for three months on large foreign orders for various of their steam specialities, and have further foreign orders on their books waiting to be executed.

THE KESTNER CLIMBING FILM EVAPORATOR.

By Leon Pellet.

The Kestner Climbing Film Evaporator, that we have pleasure in introducing to-day to the readers of *The International Sugar Journal*, is certainly not a new apparatus to many of them, in view of the large number of these apparatus that are now working with the greatest success in various industries in all countries.

The extremely interesting principle, upon which the evaporative power of this apparatus is based, is the phenomenon of the "climbing film." This gives the apparatus all the qualities that are required in a theoretically perfect evaporating apparatus.

Let us consider vertical tubes 23 feet high, heated externally by steam, and fed at the base with juice at a very low head. As is clearly indicated by Fig. 1, the first particles of the evaporated juice form bubbles of vapour which rapidly disperse, making a single column of vapour, occupying the whole of the tube, and, by its speed, carrying with it the liquid, which climbs up the walls. This experiment can be easily made with glass tubes.

Mr. Kestner has also made the following experiment: The liquid is coloured at the base, and the colouring does not appear at the top of the tubes until one or two minutes after the liquid has climbed, although the speed of the vapour is about 65 feet per second.

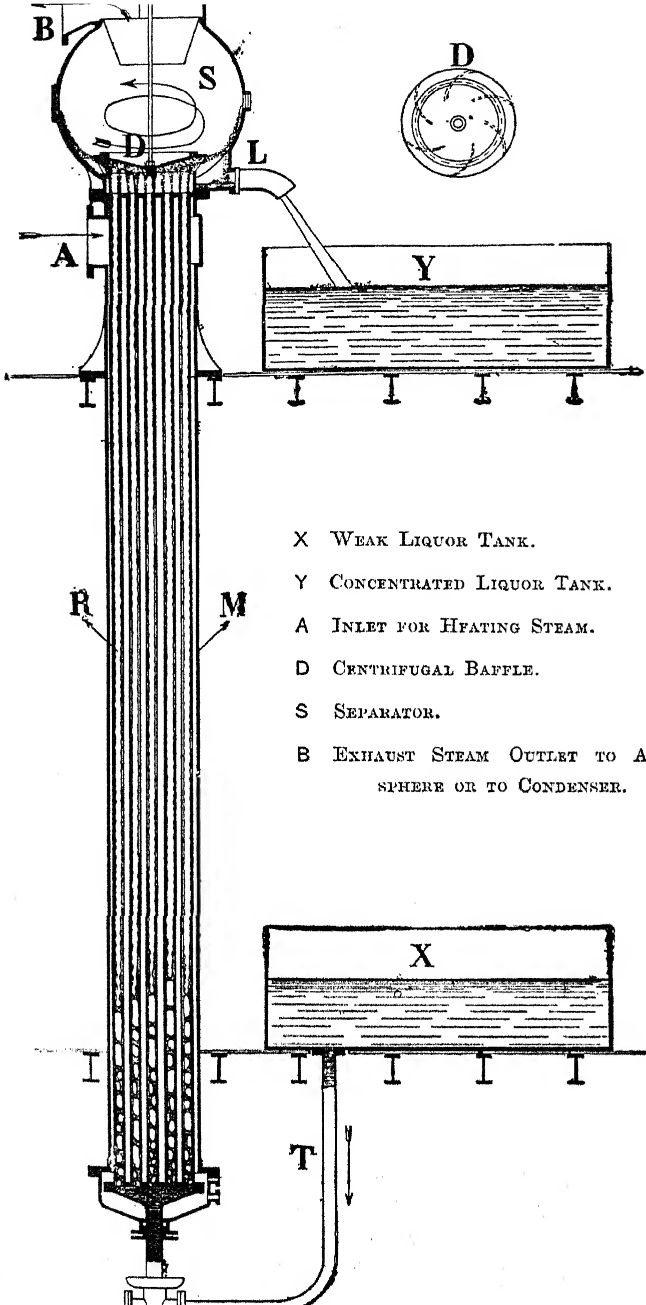
The apparatus is composed of tubes 23 feet high, having a diameter varying from 1½ to 3 inches, according to the nature of the liquid and the conditions required.

The principle upon which the apparatus is based, and the speed with which the juice circulates, give three great advantages:—

1. The Kestner Climbing Film Evaporator has a greater evaporative power than any other existing apparatus. At the Niezychowo Sugar House, the co-efficient of transmission per square metre per minute, and per degree of fall, attained an average of 96 calories, whereas 50 is usually the maximum.

2. The juice remains hardly two minutes in the pan, and suffers from no decomposing action due to the heat. This enables one to use the Kestner apparatus advantageously as a pre-evaporator or Pauly, with steam at 245° to 260° F., without any fear of alteration.

3. The speed at which the juice circulates produces an automatic cleaning of the tubes, any incrustation being swept from the surface as soon as it shows a tendency to form. It is for this reason that the Kestner multiple effect evaporators are used in the concentration of a certain number of liquids containing salt, where it is impossible to use other apparatus.



X Weak Liquor Tank.

Y Concentrated Liquor Tank.

A Inlet for Heating Steam.

D Centrifugal Baffle.

S Separator.

B Exhaust Steam Outlet to Atmosphere or to Condenser.

To these advantages we may add another which is of very great importance in certain cases. The apparatus being of the vertical type, takes up, so to speak, no ground space. An apparatus having 2000 square feet of heating surface is only 3 feet in diameter. It is easily seen that this would be very useful if it is required to augment the power of an evaporating apparatus, where very limited floor space is available.

Finally, it is found that the centrifugal separation of the vapours and liquors works with simplicity and great certainty, so that there is absolutely nothing to fear from entrainment. The Kestner apparatus are used for concentrating logwood extracts and liquorice juice, both of which foam to a great extent, and there is never any entrainment.

All the advantages just mentioned are the results of information given by the different proprietors and users where Kestner apparatus have been installed, and amongst which may be mentioned :—

The Niezychowo Sugar House (Germany) where a Kestner Climbing Film Evaporator of 125 square metres (1340 square feet) is working as the first effect of a triple effect under pressure, this triple effect then supplying steam for a triple effect under vacuum.

Mr. Gropp, director of this sugar house, gave a very interesting paper on this subject to the Eastern Section of the German Sugar Association, which was reproduced in the *Bulletin de l'Association des Chimistes* of March, 1907.

A pre-evaporator of 175 square metres (1881 square feet) installed in the Wreschen (Germany) Sugar House, furnished the same results as those at Niezychowo.

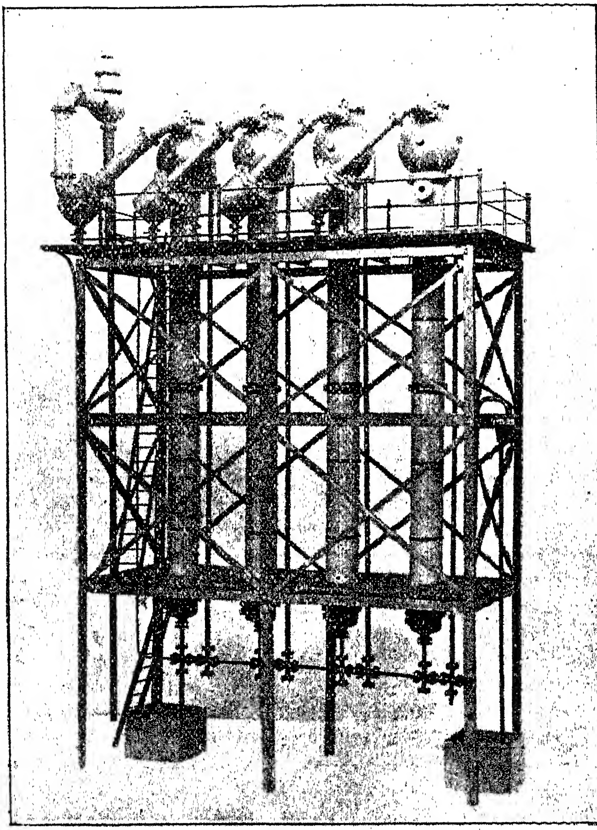
In the cane sugar industry, the presence of reducing sugars would make one fear an increase in the discolouring; but during the whole of the last crop a double effect of 2623 sq. ft. total surface, was at work in the sugar house of Terre Haute in Louisiana, and the proprietors Messrs. Graugnard & Reynaud, were completely satisfied with it. The letter in which they finally accepted the apparatus was published in the *Louisiana Planter* on the 22nd February, 1908, and can be summed up in a few words as follows :—No discolouring—no entrainment—no incrustation.

A Kestner pre-evaporator of 1344 square feet is also working with great success at Mr. Chopitea's Cane Sugar Factory in Peru.

In addition to these we may mention a double effect apparatus which has been installed for the concentration of golden syrup, and by means of which the discolouring of the syrup concentrated has been diminished.

To sum up briefly, it is easily seen that the Kestner Climbing Film Evaporators offer considerable advantages over the ordinary apparatus. This explains their great success, and why more than 330 of them have been installed in the last four years for the

concentration of the most diverse liquors, and at the same time those which are most liable to incrustation (aluminate, soda Leblanc, &c.), the most sensitive to the action of heat (sugar juices, milk, wood extracts, &c.), the most difficult and the most foamy, such as gum and gelatines, wool wash, &c.



Quadruple Effect Evaporator.

Finally, in the sugar industry, the Kestner apparatus has had a very interesting application, namely that of the continuous concentration at a very high density of juices and syrups. It has been possible with this apparatus to concentrate up to 95° Brix.

This would be a great advantage to sugar houses which, having but a very small boiling apparatus for the first "products," can increase

their production by using their "second products" apparatus for the first, and erecting a small Kestner apparatus (having but a few metres of heating surface, taking up hardly any room, and working continuously) for boiling to string proof, and sending their syrup to the exhaust tanks. In this case the apparatus used should be the "descending film" type.

In refineries, the Kestner evaporators can be economically employed for using the exhaust steam for either the first part of the concentration of sugar syrups, or for evaporating the wash waters and waste waters, &c. In pure sugar syrups there is absolutely no discolouring to fear.

A few words in conclusion about the action of heat on sugar products will be of interest. Mr. Kestner has been able recently to concentrate continuously syrups up to 95° Brix (1·52 density), making them leave the apparatus at a temperature of 263° Fahrenheit without any more discoloration than when using ordinary boiling pans. To obtain the same concentration while working under a vacuum with ordinary apparatus would result in a great increase in the discoloration.

SECOND INTERNATIONAL CONGRESS OF THE SUGAR AND FERMENTATION INDUSTRIES.

The opening meeting of the Second International Congress of the Sugar and Fermentation Industries took place at Paris, at the Hôtel des Sociétés, on the 6th April, the President, Dr. Manoury, being in the chair. Amongst the members present were: Messrs. Dupont, Vivien, Saillard, Sachs, Aulard, Zacharias, Brown, Stoklasa, Pothora, Herzfeld, Stromer, and Höpke. There was a good attendance of members. On the evening of the 10th April a dinner was given at the Hôtel Continental. The Minister of Commerce, who presided, bestowed honorary distinctions upon Messrs. Sachs, Rivière, and Robert. During the sitting of the Congress excursions were made by the members to notable places of interest, such as the Institute Pasteur, the Conservatoire des Arts-et-Métiers, the Brasserie Karcher, to Rheims, and to Epernay.

Of the papers read before the Congress, mention may be made of the following:—

New studies on the pectin substance of the beetroot; its influence on analytical results and behaviour during the manufacture of beetroot sugar, by J. Weisberg.—The following conclusions are drawn by the author:—(*a*) The pectin substance of the beetroot, which is transformable by the action of alkalies into metapectic acid and soluble metapectates, forms two classes of bodies (*a*) a pentosan, which yields furfural with hydrochloric and sulphuric acids, and oxalic acid by

oxidation with nitric acid; (*b*) a galactan, giving mucic acid by oxidation with nitric acid. By hydrolysis, the pectin substance, as well as its derivative metapectic acid, is converted into the pentose arabinose and the hexose galactose, the former of these derivatives being formed from the pentosan body and the latter from the galactan. (2) The quantity of dextro-rotatory pectin substance passing into solution with the sugar during warm aqueous digestion can rise to 2·5-3·0 per cent. of the sugar. This may, however, be completely precipitated by basic lead acetate, if care be taken to avoid excess and to not prolong the time of heating longer than is actually necessary for the complete extraction of the sugar. (3) Continued heating of the dextro-rotatory pectin substance in the presence of a large excess of basic lead acetate conduces to the formation of laevo-rotatory, metapectic acid, which is capable of lowering the polarization of the sugar. Metapectic acid and the metapectates are not precipitated by basic lead acetate solution; they are, however, completely thrown down when ammoniacal basic lead acetate solution is used, and the precipitate obtained contains the whole of the laevo-rotatory substance which was in solution. (4) The quantity of dextro-rotatory pectin substance which, under normal circumstances passes into the diffusion juice, is about 0·10-0·12 per 100 c.c.; this is a relatively small quantity compared with that remaining in the exhausted pulp. The pectin substance contained in the diffusion juices is completely precipitated by the chalk during clarification in the state of calcium pectate. The quantity of this last named compound, which dissolves in the wash waters from the filter presses, is exceedingly small and practically negligible. (5) Under normal conditions of analysis and of manufacture, metapectic acid is not formed, provided the beets used are in a good state of preservation. (6) The determination of the pentosan (as a component part of the pectin substance) by the furfural method, in the clarified juices in which large quantities of sugar and other organic substances are present, does not yield satisfactory results. (7) Basic lead acetate possesses a new and valuable property, for by its use it is possible to judge the pectin substance content in the diffusion juices and also to ascertain, in so far as the pectin substance is concerned, whether the clarification has been properly effected. (8) The pectin substances and its derivatives present a very interesting group of polarizing substances which, according to conditions, are more or less capable of influencing the analytical figures of the factory control. (9) The other polarizing substances contained in the beet, excepting raffinose, are more of theoretical than of practical interest. (10) The present researches of the author complete and confirm the results which he obtained in 1888-1889 in his investigations on the nature and action of the pectin substance of the beetroot.

Digestibility of dried pulp, by A. E. Baeck.—The opinion is often expressed that beetroot cossettes, when dried at a high temperature,

and especially when they remain a long time in the driers, are reduced in digestibility. The author has had the opportunity of carrying out a number of experiments in which the drying of the pulp was effected by the improved Petry and Hecking apparatus. The diffusion pulps were pressed until their dry substance content was 16·46 per cent. Two trials were then made; in the first the final drying temperature was 100°C., and the water remaining in the dried product 12·30 per cent.; in the second the final temperature was 140°C., and the water content 6·47 per cent.; in both cases the initial temperature of the drier was the same. The total protein and the degree of digestibility according to the Stutzer-Wedemeyer method were determined, and the following results obtained:—

	Protein per cent. on dry substance.	Co-efficient of Digestibility.
Fresh pulp, after pressing	7·05	77·60
Pulp dried at 100°C.	6·59	91·37
Pulp dried at 140°C.	6·55	85·72

The values obtained for the co-efficient of digestibility show, in accordance with the figures of Herzfeld and Lehmann, that the digestibility of the nitrogenous matters of the normally dried pulp is notably higher than in the fresh pulp, and that, moreover, even an excessive dessication gives a product whose digestibility well exceeds that of the fresh product. From the experiments it may be concluded that the digestibility of the pulp is not reduced in digestibility by dessication, and that the newer apparatus, which allows of the direct utilization of the waste gases from the grates of the boilers, give an excellent result, and moreover advantageously utilize the lost heat without having any deleterious influence on the quality of the dried product.

Identification of lævulose in presence of other natural sugars, by J. Pieraerts.—No rapid and certain qualitative test for the detection of lævulose in the presence of other natural sugars has hitherto been published. The value of Seliwanoff's solution for this purpose is questionable, and it is certainly useless if the substance being tested also contains sucrose, raffinose, or other sugar having the lævulose group, the reaction with resorcinol hydrochloride being common to all these. The author of this paper claims to have found a reliable method of detecting lævulose when in admixture with any other natural sugar; this method is based on the fact that lævulose reduces certain copper solutions more rapidly than any other sugar. The conclusions drawn from the results of his experiments are as follows:—

(1) By the use of alkaline copper solutions, and by following a certain method of procedure, the presence or absence of lævulose in products containing other natural sugars having copper reducing

properties, can be readily affirmed or denied. (2) The use of Fehling-Soxhlet solution, as a means of identifying lævulose, is untrustworthy. (3) Neither can Ost's No. II. solution be recommended. (4) Ost's No. I. and No. III. solutions are both reliable for this purpose. The latter is the more preferable; it contains 15 grms. crystallized cupric sulphate, 100 grms. potassium bicarbonate and 140 grms. of potassium carbonate per litre. When pentoses are present, the reduction is allowed to proceed for 1½ hour in the cold; in the absence of pentoses, lævulose is readily identified by heating the solution under examination with the reagent to a temperature of 35° C. for one hour. (5) Alkaline solutions of cupric hydroxide, and cupric glycocoll solutions, both give very favourable results, even in the presence of pentoses. The former of these reagents can be made by dissolving 6 grms. of cupric hydroxide in a solution containing 75 grms. potassium bicarbonate and 100 grms. potassium carbonate, and making the whole up to a litre. This solution is very stable. Neither dextrose, galactose, lactose, maltose, sucrose, nor raffinose have any reducing power towards this reagent after having been heated with one hour at 30° C.; lævulose, to the contrary, when in concentrations of from 1 to 5 per cent., readily reduces it within one hour at 30° C.

This method of testing for lævulose may be applied to its identification in commercial products such as, invert sugars, raw sugars, molasses, &c. The following method of procedure has been found to give successful results in the hands of the author: 20 to 25 grms. of the substance are dissolved in 150 to 200 cc. of cold water, the liquid defecated with basic lead acetate and filtered; the lead passing into the filtrate is precipitated by adding a sufficient quantity of a cold, saturated solution of sodium sulphate, allowing to stand for one hour, and then filtering. The amount of reducing sugars is determined in the filtrate, which is so diluted that the amount of reducing sugars present is about 5 per cent. The diluted solution is next examined for the presence or absence of lævulose, one of the solutions recommended above being used for this purpose.

Influence of certain optically active substances on the estimation of sugar in the beetroot, by K. Andrlik and V. Stanek.—Raw beetroot juices when clarified by basic lead acetate solution, and also diffusion juices, are found to give higher direct polarization readings than is to be accounted for by their sucrose content as estimated by the Clerget method. The differences (calculated on the beetroot) amount, on the average, to 0·11 per cent.; in 8 per cent. of the observations made the differences were greater than 0·2 per cent., and in 28 per cent. they were found to vary between 0·15 and 0·20 per cent. Under the influence of lime, of heat, and of carbonatation the differences observed diminished in the case of the raw juice, to within 73·77 per cent. of their original value. By warming the raw juices with

lime and by subsequent carbonatation a lower value for the polarization was observed, and this diminution is almost equal to the differences between the direct polarization and sugar content as determined by the Clerget inversion.

The authors believe that the diminution of the polarization as well as the differences between the polarization of the raw juice or of the diffusion juice and the sucrose content are caused by the presence of unknown polarizing substances which are neither raffinose, nor acid amides, but certain readily diffusible constituents of the beet juice.

Use of the refractive index for the analysis of sugar products, by D. Sidersky.—Dupont, in a paper read before the Association des Chimistes in 1887, was the first to suggest the use of the refractive index as a means of determining the dry substance of sugar solutions. At the time of his proposal, values for the refractive index of sugar solutions had not been published; since then, however, this subject has been investigated by Strohmer, who has deduced the following formula as the result of a large number of experiments:—

$$C = 1{\cdot}00698 + \frac{32{\cdot}717}{D\,(100 - A) + A}$$

in which A = the sugar content of the solution;
D = its density at 17·5° C.;
$C = \text{index}\left(n\ \frac{D}{17{\cdot}5^\circ\ C.}\right)$

The work of Strohmer was considered as being of purely theoretical interest until it was discovered that the refractive index of the non-sugar in sugar-house products differed very little from that of the sugar itself. Tollens, Smith, Main, Prinsen Geerligs, and von Lippmann have shown that, using an Abbe refractometer giving the refractive index to 14 decimal places, it is possible to determine the dry substance in juices, syrups, or molasses with an accuracy of 0·10 per cent. Hugh Main has published a table giving the ratio between the refractive index observed at 20° C. and the corresponding amounts of water of saccharine solutions, and von Lippmann (this Journal, 1898, 134 to 136) has recently demonstrated by means of a large number of observations that the dry substance content as determined by the refractometer is in close agreement with the "true" values obtained by dessication. To obtain satisfactory results with the refractometer it is necessary to carefully observe the following conditions:—

(1) The observations must be made at a temperature of exactly 20° C.

(2) It is necessary to use an instrument capable of giving the refractive index to the fourth decimal place.

Use of soluble fluosilicates in the sugar industry, by L. Rivière.—Laboratory experiments have shown that the use of hydrofluosilicic acid for the precipitation of the potash from various liquids was not capable of industrial application, the acid reagent being more costly than the base it precipitated. The use, however, of a continuous method of manufacturing the hydrofluosilicic acid would appear to offer a solution to this problem. In the case of the distillation of alcohol from molasses, treatment should be made before fermentation and the spirit obtained is, if certain precautions are observed, comparable to that obtained from wine; further, the spent washes are reduced in volume, which is an advantage even when it is not desired to evaporate them for the recovery of the glycerine and nitrogenous substances which they contain. Liquors from which the potash has been separated by hydrofluosilicic acid, cannot be properly fermented unless the excess of acid is neutralized; to avoid this, soluble fluosilicates, such as magnesium fluosilicate, may be substituted in the place of the acid. This process may be carried out with advantage on the molasses intended for stock food as the subtraction of the potash does not impair its nutrient value.

The treatment of diffusion juices with hydrofluosilicic acid before liming and carbonatation presents several advantages; by treating them with a small proportion of a soluble fluosilicate, such as the zinc salt, the mineral and much of the organic matters is thrown down; juices thus treated retain the properties of fresh diffusion juices and it is possible to preserve them, without any appreciable alteration, exposed to the air for a period of two months. This preliminary treatment is not costly because it is possible to recover the fluosilicate used and to readily prepare marketable potash; a higher rendement is obtained by reason of the diminution of the amount of molasses resulting from the precipitation of inorganic salts and melassigenic organic substances.

Use of sulphur dioxide in the refinery, by T. Henriot.—The properties of liquid sulphur dioxide, its method of employment, and the precautionary measures to be observed in its manipulation in the sulphuring of sugar juices were fully described by the author, who expressed the opinion that its use should be much more extended than it is at the present time. M. Vivien, in the discussion following the reading of the paper, said that at the Nassandre sucrerie they only use liquid sulphur dioxide for the treatment of their juices and obtain very favourable results.

The past Mauritius crop, which was estimated at 130,000 tons at the time when the loan was being negotiated for with the Home Government, has now considerably exceeded this figure; and there is a prospect of good field returns for the coming crop.

MOLASSES: ITS DEFINITION AND FORMATION.

By H. C. Prinsen Geerligs.

(*Continued from page 235.*)

In the case of the cane sugar industry, the quotient between glucose and salt and that between glucose and ash are generally high; and this induced me to carry out all further investigations under such conditions as occur in practical working.

I always mixed 120 grammes of sucrose with 50 grammes of water and as much salt as would make the amount of incombustible matter in it about 4 grammes; the quantity of glucose added to the mixtures was varied within rather wide limits. As an instance of the organic salts derived from the juice (malates and succinates) I used for convenience' sake the acetates of sodium, potassium, and lime. So as to study the influence of those organic salts that are formed from glucose during the process of manufacture, I boiled a solution containing a large proportion of glucose with small portions of lime until almost all glucose reaction had disappeared from the solution. The glucose had become transformed into lime salts of organic acids, and all of the free lime had entered into that combination. The solution was then filtered and divided into three equal parts, of which one was evaporated to a syrupy liquid and represented the solution of the lime salt, which I called calcium glucinate, though I did not pretend to attach any special chemical signification to that term. The two other portions were transformed into the corresponding sodium and potassium salts by decomposition with carbonate of sodium and of potassium. These two liquids were also filtered off and evaporated, and represented solutions of sodium and potassium glucinate respectively. Their composition was as follows:—

Lime Salt.		Potassium Salt.		Sodium Salt.	
CaO	9·53	K_2O	17·67	Na_2O	8·44
Glucose	3·	Glucose	4·	Glucose	3·
Organic acid	44·07	Organic acid	42·23	Organic acid	34·16
Water.. ..	43·40	Water.. ..	36·10	Water.. ..	54·40
	100·		100·		100·

From each one of these solutions, which, especially the lime salt, were very viscous and tough, I weighed off as much as corresponds to 4 grammes of ash, and accounted for the water and glucose present in the solution when calculating the weight of water and glucose to be weighed for the preparation of the mixtures. I next took inorganic lime, sodium and potassium salts, both alone and accompanied by organic ones, and prepared the following list of mixtures, just to show that the dissolution of the salts in a thick liquid containing

sucrose and glucose was much slower and more difficult of accomplishment than in the same amount of water without any addition of sugars.

No.	Added to 120 grammes of Sucrose and 50 gr. of Water.				No.	Added to 120 grammes of Sucrose and 50 gr. of Water.			
	Gr.		Gr.			Gr.		Gr.	
1.	0	glucose	5	pot. acetate	22.	0	glucose	5	sod. chloride
2.	5	,,	5	,, ,,	23.	10	,,	4	,, ,,
3.	10	,,	5	,, ,,	24.	30	,,	4	,, ,,
4.	20	,,	5	,, ,,	25.	60	,,	4	,, ,,
5.	30	,,	5	,, ,,	26.	10	,,	4	pot. sulphate
6.	60	,,	5	,, ,,	27.	30	,,	4	,, ,,
7.	10	,,	5	sodium acetate	28.	60	,,	4	,, ,,
8.	30	,,	5	,, ,,	29.	5	,,	4	calc. chloride
9.	60	,,	5	,, ,,	30.	30	,,	4	,, ,,
10.	5	,,	5	,, ,,	31.	60	,,	4	,, ,,
11.	30	,,	5	,, ,,	32.	7	,,	3	acet. + 3 gr. pot. sulph.
12.	60	,,	5	,, ,,	33.	30	,,	3	,, + 3 ,, ,, ,,
13.	7	,,	6	pot. glucinate	34.	60	,,	3	,, + 3 ,, ,, ,,
14.	30	,,	6	,, ,,	35.	0	,,	2½	,, + 2½ ,, sod. chl.
15.	60	,,	6	,, ,,	36.	7	,,	3	,, + 3 ,, ,, ,,
16.	7	,,	6	sodium glucinate	37.	30	,,	3	,, + 3 ,, ,, ,,
17.	30	,,	6	,, ,,	38.	60	,,	3	,, + 3 ,, ,, ,,
18.	60	,,	6	,, ,,	39.	7	,,	3	,, + 3 ,, calc. ,,
19.	7	,,	6	calcium ,,	40.	30	,,	3	,, + 3 ,, ,, ,,
20.	30	,,	6	,, ,,	41.	60	,,	3	,, + 3 ,, ,, ,,
21.	60	,,	6	,, ,,					

After the time necessary to allow the sucrose to crystallize out had elapsed, the crystals were separated from the liquid, weighed and the latter analysed. The sucrose was determined by Clerget's method of polarization before and after inversion, and the other constituents ascertained in the ordinary manner. As the solubility of the sugar in 100 parts of water could be found by calculation, we could also calculate how much sucrose was dissolved in the 50 grammes of water of the mixture; that figure, added to that of the sucrose crystallized out and subtracted from the figure of 120 grammes, yielded the weight of sucrose lost by inversion during the heating and cooling of the samples. This value is however calculated from so many analytical results, which are all susceptible to slight errors, that it cannot claim great accuracy. It is therefore very probable that in some instances, where the list mentions a small loss by inversion, this latter has not really occurred, and the discrepancy is due to an accumulation of analytical errors.

All the figures, both those found on analysis and those calculated out, are gathered together in the tables appended:—

Constituents.	Potassium Acetate.						Sodium Acetate.		
	1	2	3	4	5	6	7	8	9
Weight in grammes :—									
Sucrose crystallized out.	18·50	5·3	17·5	21·8	24·3	29·0	5·4	14·3	18·2
Sucrose dissolved	101·5	105·0	103·0	99·0	96·0	80·5	113·5	104·0	97·0
Sucrose inverted	—	9·7	—	—	4·7	—	1·1	1·7	4·8
Composition of the solution in per cent. :—									
Sucrose	64·20	62·20	61·30	56·60	52·00	42·30	62·60	53·20	45·30
Glucose	0·80	5·31	6·20	11·50	16·70	29·10	5·20	17·30	27·80
Ash	2·50	2·10	2·01	2·07	2·08	1·80	2·36	2·24	1·77
Water	31·60	29·60	29·80	28·90	28·62	26·20	27·50	25·50	23·30
Undetermined	0·90	0·79	0·69	0·93	0·60	0·60	2·34	1·76	1·83
Glucose : Ash	0·32	2·53	3·07	5·55	8·03	16·17	2·20	7·80	16·0
Sucrose on 100 water ..	203	210	206	198	182	161	227	208	194

Constituents.	Calcium Acetate.			Potassium Glucinate.			Sodium Glucinate.		
	10	11	12	13	14	15	16	17	18
Weight in grammes :—									
Sucrose crystallized out..	14·5	36·8	40·1	23·5	35·8	33·4	24·1	29·7	30·1
Sucrose dissolved	102·5	81·0	79·0	93·5	82·5	85·0	92·5	84·5	82·0
Sucrose inverted	3	2·2	0·0	3	1·7	1·6	3·4	5·8	7·8
Composition of the solution in per cent. :—									
Sucrose	61·50	48·80	40·90	57·80	48·40	41·80	57·60	48·60	40·40
Glucose	4·30	18·30	30·04	7·10	17·60	29·60	7·31	19·20	30·80
Ash	2·02	1·78	1·44	2·10	2·13	1·76	1·85	1·62	1·44
Water	30·01	29·46	25·91	30·80	29·30	24·60	30·50	28·78	24·73
Undetermined	2·17	1·66	1·71	2·20	2·57	2·24	2·74	1·80	2·63
Glucose : Ash	2·12	10·3	20·90	3·40	8·26	16·82	4·0	11·85	21·40
Sucrose on 100 water ..	205	162	158	187	165	170	185	169	164

Constituents.	Calcium Glucinate.			Sodium Chloride.			
	19	20	21	22	23	24	25
Weight in grammes :—							
Sucrose crystallized out	34·7	45·3	46·1	12·50	12·7	—	—
Sucrose dissolved	84·0	73·0	72·5	107	103·5	56·0	38·5
Sucrose inverted	1·8	1·7	1·4	—	3·8	64·0	81·5
Composition of the solution in per cent. :—							
Sucrose	56·50	45·30	37·90	66·20	62·20	27·20	16·70
Glucose	4·49	18·60	31·40	0·40	4·80	46·30	59·70
Ash	1·78	1·60	1·40	2·50	2·81	2·21	1·98
Water	33·66	31·0	25·20	30·90	30·17	24·29	21·62
Undetermined	3·57	3·50	3·10	—	0·02	—	—
Glucose : Ash	2·50	11·60	22·40	0·16	1·7	20·9	30·2
Sucrose on 100 water	168	146	145	214	207	112 ?	77 ?

Constituents.	Potassium sulphate.			Calcium chloride.			Potassium sulphate and acetate.		
	26	27	28	29	30	31	32	33	34
Weight in grammes :—									
Sucrose crystallized out.	2	—	—	30·3	—	—	27·0	38·1	38·7
Sucrose dissolved	103·5	102	58·5	91·5	95·0	70·5	93·5	82·5	79·5
Sucrose inverted	14·5	18·0	61·5	—	25·0	49·5	—	—	2·8
Composition of the solution in per cent. :—									
Sucrose	58·10	49·70	24·70	60·50	47·40	30·0	59·50	48·20	40·10
Glucose	11·65	24·0	52·34	4·60	25·60	47·20	4·50	18·0	30·01
Ash	2·13	1·75	1·72	1·80	1·40	1·22	3·76	3·24	3·78
Water	28·12	24·42	21·11	33·10	25·10	21·30	31·25	29·20	25·12
Undetermined	—	0·13	0·13	—	0·5	0·28	0·99	1·36	0·91
Glucose : Ash	2·7	13·7	30·5	2·5	18·0	37·9	1·2	5·5	8·0
Sucrose on 100 water ..	207	204 ?	117 ?	183	190 ?	141 ?	187	165	159

Constituents.	Sodium chloride and acetate.				Calcium chloride and calcium acetate.		
	35	36	37	38	39	40	41
Weight in grammes :—							
Sucrose crystallized out	10·7	17·2	28·2	29·7	25·1	42·1	50·3
Sucrose dissolved	109·0	102·5	90·0	87·5	94·5	76·0	68·5
Sucrose inverted	—	—	1·8	2·8	—	—	1·2
Composition of the solution in per cent. :—							
Sucrose	63·60	61·60	51·30	43·80	59·40	46·30	36·80
Glucose	0·70	4·20	16·10	28·50	4·01	18·31	32·10
Ash	5·50	3·60	3·33	2·76	4·05	3·60	2·97
Water	29·20	30·0	28·57	24·39	32·05	30·49	26·79
Undetermined	1·0	0·60	0·70	0·55	0·49	1·30	1·34
Glucose : Ash	0·13	1·16	4·8	10·3	1·0	5·0	10·8
Sucrose on 100 water	218	205	180	175	189	152	137

The mixtures containing only glucose and inorganic salts revealed a striking fact; their joint presence gave rise to so much free acid from the inorganic salt, that at the high temperature at which the solutions were made some sucrose was inverted.

For this reason the solutions of Nos. 24, 25, 27, 28, 30, and 31 must be excluded from our calculations, as in these so much sucrose

was inverted that there was not sufficient left to form a saturated solution. Not only had no sucrose crystallized out, but even the 2 grammes of sugar, used as "bait," were dissolved in every one of those six cases. This saved me the task of studying the action of inorganic salts on the solubility of sucrose in presence of glucose, while their influence in the absence of that body is sufficiently known from Herzfeld's experiments. When however organic salts were also represented in the solution, the inversion was much smaller, and in every case a fully saturated solution resulted, as is shown by the large quantities of sucrose which crystallized out. Owing to this circumstance it was only possible to study the action of the inorganic salts by comparing them with the mixtures containing organic ones.

We observe then, that in every case, where glucose and salts are represented in the solutions, the amount of sucrose crystallizing out increases in the same proportion as the liquid contains more glucose on the same amount of salts.

In the mixtures containing both organic and inorganic salts, this crystallization is analogous to that found in those which contain the same amount of organic salts only, which shows that in this respect the action of the organic and the inorganic salts does not differ. So the mixtures Nos. 33, 34, 37, 38, 40, and 41, are respectively the same as Nos. 5, 6, 8, 9, 11, and 12, with only this difference that a part of the acetate has been replaced by an equivalent amount of an inorganic salt and yet the weights of sucrose crystallized out in every set of two corresponding mixtures are in the same direction and similarly those of the sucrose dissolved. A completely identical result cannot be expected as every salt has an action of its own, but we see that substitution of a part of the organic salt by an equivalent weight of an inorganic one has a slight tendency to promote the crystallization of the sucrose.

No. of the mixture.	Salts.	Grammes of Glucose	Grammes of Sucrose. Crystallized out.	Grammes of Sucrose. Dissolved.	Grammes of Sucrose. Inverted.
5	Potassium acetate	30	24·3	96·0	4·7
33	Potassium acetate and pot. sulphate	30	38·1	82·5	—
6	Potassium acetate	60	39·0	80·5	—
34	Potassium acetate and pot. sulphate	60	38·7	79·5	2·8
8	Sodium acetate	30	14·3	104·0	1·7
37	Sodium acetate and sodium chloride	30	29·7	90·0	1·8
9	Sodium acetate	60	18·2	97·0	4·8
38	Sodium acetate and sodium chloride	60	29·7	87·5	2·8
11	Calcium acetate	30	36·8	81·0	2·2
40	Calcium acetate and calc. chloride	30	42·1	76·0	—
12	Calcium acetate	60	40·1	79·0	—
41	Calcium acetate and calc. chloride	60	50·3	68·5	1·2

The calcium salts exert the strongest influence, next come the potash salts, and finally the soda salts.

After we have seen that the simultaneous presence of any kind of salts and glucose promotes the crystallization of sucrose, which crystallization is the most abundant when in a given amount of salts the proportion of glucose is greatest, we can take a step further, and in explaining this fact can at the same time explain the whole molasses-forming theory.

We have already remarked that in the absence of glucose, molasses is a hydrated combination between salts and sucrose, which in concentrated state is stable and is only dissociable when in a very dilute state. If we add invert sugar to that combination, then the salts will combine as well with the glucose and fructose as they did with the sucrose, which will give rise to a sucrose-glucose-fructose-salt combination, or more shortly a sugar-salt combination. The proportion in which the five components (three sugars, water and salts) mutually occur depends of course exclusively on the casual circumstances of relation and nature of the salt; but at any rate, in presence of glucose or invert sugar less sucrose enters into combination for the same amount of salt, than when invert sugar had not been present in the mixture. This amount of sucrose becomes free and can crystallize out more abundantly.

If this hypothesis be true, then we must expect, when mixing dry glucose with a quantity of the sucrose-salt combination, to see a part of the sucrose displaced by the invert sugar and so enabled to crystallize.

For the same reason, when bringing together a saturated solution of sucrose with glucose and a dry salt, the salt will combine with the sugars and with water, and if the conditions of the experiment are well chosen there will not remain sufficient free water left to keep all of the still free sucrose in solution; that surplus will, therefore, crystallize.

With a view to proving these facts experimentally, I prepared the undermentioned mixtures and kept them until all the superfluous sugar had crystallized.

I. 120 gr. sucrose, 50 gr. water, 10 gr. potassium acetate.
II. 120 ,, 50 ,,
III. 120 ,, 50 ,, 100 gr. anhydrous glucose.

As was to be expected from the foregoing experiments, Nos. II. and III. deposited about 15 grammes of sucrose, while the amount of 10 grammes of acetate of potash was chosen, because with that proportion we know the same quantity of sucrose, 15 grammes, would crystallize out, causing the proportion between sucrose and water of the fully saturated and not oversaturated solutions poured off from the crystals to be about the same. These clear syrupy liquids were transferred to other flasks, and mixed with 100 grammes of anhydrous glucose in either No. I. or II., and with 10 grammes of

dry acetate of potash in No. III., after which the flasks were again set aside for crystallization. After six weeks 21 grammes of sucrose had crystallized in No. I., in No. II. nothing, and in No. III. 24 grammes; which is, therefore, in full agreement with the theory profounded. By way of confirmation, however, I repeated the experiment by mixing 300 grammes of a just saturated solution of sucrose and acetate of potash with 225 grammes of anhydrous glucose. Another portion of that same sucrose-acetate of potash solution was kept without any addition as a check, and both were again put aside for a couple of months for crystallization. The former solution containing glucose still yielded a crystallization of 75 grammes of sucrose, while the check solution (without addition) remained wholly uncrystallized.

The composition of the mother-liquor and the solution was as follows:—

	Original.		With Glucose.
Sucrose	64·4	....	37·5
Glucose	2·94	....	36·6
Water	30·80	....	24
Ash	0·97	....	1·26
Undetermined	0·89	....	0·64
	100		100

On 100 parts of syrup we added 45 grammes of glucose whilst 15 grammes of sucrose crystallized out, bringing the weight of the second syrup to 130 grammes. When calculating the probable composition of the mother liquor we get these values:—

$$\text{Sucrose}\ \frac{(64{\cdot}4 - 15) \times 100}{130} = 38 \text{ (found to be } 37{\cdot}5).$$

$$\text{Glucose}\ \frac{(45 + 2{\cdot}94) \times 100}{130} = 36{\cdot}8 \text{ (found to be } 36{\cdot}6).$$

$$\text{Water}\ \frac{30{\cdot}8 \times 100}{130} = 23{\cdot}7 \text{ (found to be } 24).$$

There is thus a full agreement between the calculated composition and the figures actually found on analysis, which also very clearly proves that in a glucose-free molasses any addition of glucose can displace a part of the sucrose from the combination and bring it again to crystallization. This brings us to the ultimate conclusion and definition of molasses, viz.: *Molasses is a hydrated combination between sugars and salts, which cannot be broken up by evaporation, and therefore cannot give off sugar in a crystallized form.*

The total amount of sugars (sucrose + glucose + fructose) in an exhausted cane sugar molasses may be put down as about 55% and it depends solely and entirely on the proportion of reducing sugars (glucose + fructose) to the same amount of ash, in what proportion

the different sugars go to make up that 55%. The water content is about 20%, and the figure for the ash about 9%. In the case of the juice containing no reducing sugar, the salts combine with sucrose only and sucrose is the only kind of sugar represented in the 55%, so that the proportion between sucrose and water is in this case as 55 : 20. If, on the contrary, the juice contains reducing sugar as well, then this will also combine with a part of the salts, causing that same quantity of salts to hold less sucrose in the combination. If for instance the amount of reducing sugar be 10% and therefore that of the sucrose 45%, then we find on 20 parts of water only 45 parts of sucrose and when observing a very normal proportion, which very often occurs in cane sugar molasses, of 30 sucrose and 25 reducing sugar, we only find a proportion of 30 sucrose against 20 water.

Up to now there has always been a question raised of the increase or decrease of the solubility of sucrose in the water of the molasses, and that point of view has during a very long period dominated the whole study of molasses-formation. If we allow that idea to hold for a moment, we notice the following solubilities for the corresponding relations between sucrose and invert sugar:—

Invert	sugar	0	275	parts of sucrose	on 100	water.
,,	,,	5	250	,,	,,	,,
,,	,,	10	225	,,	,,	,,
,,	,,	15	200	,,	,,	,,
,,	,,	20	175	,,	,,	,,
,,	,,	25	150	,,	,,	,,

In the above list we have put together all the possible cases, and from it we see that the so called solubility of the sucrose in the water falls when the amount of glucose (or, in general, invert or reducing sugar) on the same amount of salts rises. Generally speaking, we can say that with a high quotient between glucose and ash, the solubility of sucrose decreases.

I hasten at once to add that this statement is far from being precise and is apt to give rise to much confusion. There is no question of solubility of sucrose at all, but only of the composition of a combination, which contains on an average 55% sugars, 25% salts, and 20% water. If there is a big proportion of reducing sugar in that portion of 55%, then there is little left for the sucrose; if on the contrary the percentage of glucose is small, the syrupy combination contains much sucrose. It is after all a mere surmise, that in those combinations the proportion between the sucrose fixed therein and the fixed water is now smaller and now greater than that of pure water and pure sucrose in saturated solutions, but, as I said, all this is purely guess-work, and has nothing whatever to do with a special positive or negative melassigenic power of the constituents of the molasses.

It is evident that in my theory there is no place left for negative molasses-formers; the non-sugars, especially salts, combine with sugars, and it depends entirely on the mutual relation of sucrose and glucose whether much or little sucrose will enter into the combination.

Further, it is clear that if one wants to study the conditions of the formation of molasses, one has to stick to exactly similar circumstances as occur in practical working. We must, therefore, start from an excess of sugars, chiefly sucrose, over the salts, because in practical sugar manufacture the sucrose always predominates in the juices and syrups; it grows constantly less and less through consecutive crystallizations until there is no more left than just corresponds with its maximum amount in the combinations mentioned in this paper. The study of the raising or lowering of small portions of foreign bodies when brought in contact with huge portions of sucrose may be interesting from a scientific point of view, but its conclusions are quite useless as an explanation of molasses-formation.

BRITISH GUIANA AND ITS DEVELOPMENT.

On March 24th last a paper was read by Mr. E. R. Davson on "British Guiana and its Development" before the Royal Colonial Institute. Much of it was taken up with a discussion of the labour question and the problem of immigration. The lecturer considered it clear that immigration was necessary to develop the resources of the country, and he was convinced that East Indians were the best type for the purpose. He accordingly put forward some carefully considered proposals for increasing the annual indent of these immigrants. We do not deem it necessary to refer to his suggestions here; but we think our readers will find the following extracts from Mr. Davson's paper (where he details some general information regarding British Guiana) of sufficient interest to be worth our reproducing.

British Guiana has an area, roughly, of 90,000 square miles, an area rather larger than that of Great Britain. Its population, according to last year's estimate, was 306,000 persons; therefore it has a population of a little over three persons to the square mile. Of this population about 120,000 are males over fifteen years of age. This gives a population of one and one-third adult males per square mile, and this simple statement, to my mind, establishes beyond question or argument the great and crying need for further population.

Let us now analyse the present population. There are 15,000 Europeans, 129,000 East Indians, 117,000 native blacks, 35,000 mixed races, and 10,000 Chinese, Africans, and Aborigines. It will be seen, therefore, that the whites only number 5 per cent. of the population, while the East Indians are numerically the strongest race; but, on the other hand, a portion of those stated as "mixed races" may be considered as supplying the higher class of the coloured Creole community.

Of the coast lands 74,500 acres are under sugar-cane cultivation, this acreage being divided among 47 sugar estates: 30,000 acres are under rice; there are 18,000 acres in plantains and ground provisions, 7000 acres in cocoanuts, 2000 acres in cocoa, and 1500 acres in coffee. That comprises the whole agricultural production of the Colony—74,500 acres of sugar-cane and 67,500 acres in other produce.

In the forest belt of the interior there is a small portion of the land held under timber-cutting licenses; there are larger tracts held for the collection of balata, a kind of gutta-percha, of which the annual export is about 400,000 lb.; 86,000 oz. of gold, of the value of £320,000, were exported in 1906; and 66,000 diamonds, weighing close on 5000 carats, were brought to the coast.

I have mentioned these items so that you may see that the present production of this vast country is very small when compared with what should be when the country is developed. For the coast line has a seaboard of 300 miles and a depth of some 20 miles; and if the people were there to settle, there is scope for a vast extension of sugar and rice and for the introduction on a large scale of other products. With a population to settle on the river banks, there would be homesteads growing cocoa, cocoanuts, coffee, fibre, and citrous fruits; with the introduction of capital, railways should open up the interior, and there would be found timber tracts of undoubted value; there would be the opportunity of growing rubber in a congenial soil, and the greater and more lucrative prosecution of the gold and diamond industries. And behind the coast lands and the forests comes the third section of the Colony—the rolling savannahs of the plateaux, where there is opportunity for cotton and fibres, and room for flocks and herds, to supply neighbouring markets, and also to be in preparation for those markets of the future which will be found when the Panama Canal unites East and West.

As already stated, there are 47 sugar estates in the Colony, and these produce an average crop of 100,000 tons of sugar which, with the by-products of rum, molasses, and molascuit cattle-food—a most promising addition to the Colony's exports—gives a value of, say, £1,212,000 as against a total export, including goods re-exported, of £1,843,000.

When it is borne in mind that of this sugar value of £1,212,000 nearly one-half is circulated in wages on the estates, it will at once be seen what an important part these estates play in the Colony's welfare.

Now I am not going to devote much time to the sugar industry, not because I do not recognise its importance, but because a consideration of it would require a paper devoted to this object alone.

Let it suffice to say that sugar remains the backbone of the Colony, and, although I hope that other industries in course of time will grow to rival it for the premier place, yet the failure of the sugar industry at the present would bring general disaster and put back the clock of progress many years.

I would, however, touch on one point in connection with the sugar industry. It is frequently suggested that owing to fiscal, labour, or natural advantages, cane sugar can be produced in other countries, such as Java, Peru, and Cuba, at a lower cost than in British Guiana, and it is contended that the local sugar industry must for this reason eventually be worsted. I am not prepared to accept this view, for although it may be admitted that sugar can be produced more cheaply in especially favoured spots, yet these spots are not sufficient to supply the world's demand. The present main sources of the world's supply are the European States. Therefore, as long as present conditions continue, if British Guiana can produce its sugar at a less or even the same price as European beet—which it can do—it will be able to find a place in the world's markets. It is again said that in future tropical countries will produce cane sugar in such vast quantities as to kill even the beet industry. That may be; and if it should come about—if tropical cane sugar should become the only sugar of the future—I still cannot see why British Guiana should suffer, for, be it remembered, it is not standing still. The renewal of the Brussels Sugar Convention guarantees it fair play in the world's markets for the next five years; its methods are constantly improving, and the experiments in growing fresh varieties in cane, and in cross-fertilization, which are being assiduously conducted in Guiana by Professor Harrison, and in Barbados by Sir Daniel Morris, encourage us to hope that its productiveness may yet be greatly increased.

The Great Western Railway of Brazil at its last annual meeting had to record a falling off in the amount of sugar hauled of no less than 40 per cent. This loss, arising from short crops, had a considerable effect on the company's income for the year.

STUDIES IN SUGAR MANUFACTURE.

By A. Aulard.

(*Continued from page 248.*)

I assisted several times in the desugarizing and cleansing of the sand filters; the desugarizing carried out to 2° Baumé gives a final product having almost, if not quite, the same purity as the initial running of 79 to 80; issuing out at 25°, it goes on to aid the dilution of the centrifugal runnings. As soon as the washing properly speaking is accomplished, a dirty, blackish and very greasy water is left behind, the grease being due to the action of the sulphurous acid on the fatty matters in the presence of lime.

It was not merely that the purity of the juice was appreciably increased by this sulphitation and the subsequent filtration through sand, *i.e.*, a matter of half to 1 degree, but the physical condition of the product became considerably modified. I could only suggest by way of comparison the work which I turned out in 1904-05 in the Amougies sucrerie.

The products which have been sulphited and filtered over sand always give me 5 to 7 kg. of sugar at least per hectolitre of second jet masse-cuite. With Mr. Karlik, the limpid runnings raised to a temperature of 55° C. are introduced into a horizontal vessel, invented by Messrs. Karlik and Czapikowski, and constructed by the eminent house of Breitfeld, Danek & Co. In this cylindrical apparatus, the heating surface consists of a stirrer formed of steel tubes arranged in the form of a cross. This tubular body, which is six metres long and is fitted with two steam delivery pipes and a drain pipe for the condensed water, makes one revolution per minute. M. Karlik told me that it had only 32 square metres of heating surface for dealing with a strike of 220 to 230 hectolitres in 24 to 36 hours of boiling, employing solely the steam from the first vessel, *i.e.*, a pressure of one-tenth. This is a very considerable advantage over the vertical systems of Freitag, Grosse, &c., inasmuch as these latter require a heating surface four or five times as great to obtain a result which is certainly not any better. I followed the boiling of the after-products through all its phases at Nymburg. The runnings, first filtered through sand, were introduced into the pan till the revolving arms were covered, then with the apparatus continuously in movement the mass was concentrated till its temperature reached 80° C. and the vacuum 54 centimetres. The vacuum was then raised rapidly to 60 cm. and the temperature allowed to fall and by the supersaturation the formation of very small crystals was induced and was continued without cessation by regularly introducing fresh supplies of sulphited and filtered runnings. During the whole period of crystallization the

vacuum remained in the neighbourhood of 54 cm. and the temperature at about 80° C.

The grain, fed at a high temperature by a fluid and limpid product, is vigorous and well shaped; it is neither amorphus nor soft; after passing though one of three coolers it gives in 24 or 36 hours a clear sugar which centrifugals well, even though the centrifugalling be sluggish owing to the low temperature (40° C.) of the malaxeured product.

With M. Karlik it is customary to let the second jet masse-cuite cool to 81° or 82° C., the vacuum being no more than 32 or 35 cm., it is dried in the apparatus to a maximum of 5 per cent. of water, but at the moment of cooling it a certain amount of centrifugal runnings from the preceding operation is introduced to raise its water content to 8 per cent. This running is heated to 85° C.

The mass is then cooled in a special apparatus designed by Messrs. Karlik and Czapikowski, which consists of a trough-shaped malaxeur of 250 hectolitres capacity in which are fitted a number of horizontal tubular arms constructed on the same principle as that of the boiling apparatus; these arms revolve in the mass to be cooled at the rate of one revolution per minute. According to the conditions ruling in the sugar market, the quotient of purity of the molasses can be reduced to 53 or 54, but Mr. Karlik prefers to leave a molasses of 58 to 59 purity.

In further boiling experiments I witnessed at Nymburg the hot runnings of a masse-cuite having a purity of 79·25 were cooled without any introduction of fresh molasses and then showed a purity of 65·38 (a fine result) the temperature of the original mass being 81°C. This masse-cuite, on being cooled in a Karlik crystallizer for 24 hours, gave at a temperature of 50°C. a running having a purity of no more than 59·84. Thus, after 26 hours' boiling and 24 hours' cooling, 50 hours in all, the purity fell from 79·25 to 59·84, a drop of 19·41, a thing I have never experienced before in the course of my long sugar career. The masse-cuite was, however, left in the crystallizer another 24 hours; the running then registered 59·27 purity at 40°C. temperature, showing the very small gain of 0·57, and on centrifugalling 24 hours later, that is 62 hours after the cooling was begun, a purity of 59·04, another insignificant gain of 0·24 after 24 hours, all of which gains, obtained, be it noted, by a supplementary crystallization of 48 hours' duration, only lowered the purity by 0·80. What this amounts to in the course of manufacturing 40,000 tons is only a saving of 135 tons of raw sugar! Is it really worth the trouble? I doubt it, and that is why I consider 36 hours' cooling amply sufficient when properly carried out; this means a fall of 1 degree in temperature per hour.

I have stated in my memorandum of analyses at the Nymburg Sucrerie, made during the 1906-07 campaign, that molasses sold to a

Kolin distillery had a mean purity of 57·15 and that the purity during the present campaign varied between 56·92 and 59·70, the second jet boilings having a purity of 79·60 to 81·50. This last purity is too high, and when M. Karlik has completed his very practical installation by the addition of two malaxeurs for the first jet masse-cuites, the seconds will be confined to products of 78 purity which always give molasses of less than 58 purity.

For centrifugalling the after products, four Breitfeld centrifugals amply suffice, and, as above mentioned, the sugar, although consisting of finer crystals than those of first jet sugars, is owing to sulphitation of a clearer tint; it is, however, mixed with the first jet sugars, and this mixture constitutes a brand of raw sugar much sought after by the refineries. At Nymburg they consequently make but one kind of sugar of 90° titrage, 96 to 96·50 polarization, and 700,000 kg. of it are obtained per working day with the aid of two sets of Karlik-Czapikowski boiling apparatus, three malaxeurs of similar origin, three Haempl centrifugals, and four Breitfeld centrifugals. I doubt whether any smaller or simpler plant could turn out 1254 sacks of raw sugar per diem.

Before concluding, a few words on the production of lime at Nymburg will not be out of place. Very little coke is used in the lime furnaces—not more than 2½ per cent.—but five gasogene furnaces fed with lignite supply the rest of the heat required to decompose the limestone. The latter is well crystallized, and very white in colour considering it has a trace of iron in it. The CO_2 gas is not very rich, seldom exceeding 24 to 26 per cent. as a rule, but thanks to the Karlik distributors, and the heaters of the same designer, it is extremely well utilized, and the first carbonatation lasts no more than five to seven minutes.

While in Austria-Hungary I was struck by the smallness of the lime-kilns, and apart from those usines which employ the Kowalski process, all the others seem to prefer the quantity of 3 per cent. of lime. At Nymburg the limestone is well heated and the lime easily hydrated. Thus, in the preparation of milk-of-lime there was only a small pattern Mick apparatus in use, followed by a Koran apparatus of Breitfeld's make, which is a centrifugal straining apparatus for milk-of-lime that ought to be used by every sucrerie. The milk-of-lime is free from the least particles of grit; not a single piston of the pumps is stopped, and the wear and tear on the filter-press cloths is sensibly diminished, as the fibres are not liable to be cut by sharp flints. A *monte-jus* carries the milk-of-lime at a density of 22 Baumé to the usine, where it is received into a reservoir situated over a lime distributor fitted with counterweights and worked by electricity; the Nymburg model is a very fine one.

The whole space occupied by the apparatus for preparing the milk is only 6½ metres by 4, or in round figures 30 square metres. It is

placed on the floor of the lime-kiln adjacent to the latter's doors. Nothing is more simple or less costly. I never saw more than three men engaged in the work of shovelling in the lime and preparing the milk-of-lime.

As to the generators, time failed me to verify whether all that I was told about them was correct. There are nine Fairnbein boilers, each of 180 square metres heating surface, of which eight are at work, and the ninth in reserve. Two sorts of fuel are used: coal, which costs delivered 32 crowns per ton (33·60 frs.), and lignite, which costs 24 crowns (25·20 frs.). According to the factory manager, they consume 75 kilos. of fuel, ⅓ coal and ⅔ lignite, per ton of beets, costing 2·184 frs., or 1·250 frs. per 100 kilos. of raw sugar.

The production of molasses is less than 1½ per cent., but a certain part of them are carried off in the raw sugars of 90° titrage.

STRIPPING EXPERIMENTS IN HAWAII.

For some years past the Agricultural Division of the Hawaii Sugar Experiment Station has been engaged in experiments to determine the influence of stripping on the yields of cane and sugar. A Bulletin (No. 16) was issued in 1906 giving some details of the work and the conclusions drawn therefrom, of which a rèsumè appeared in this Journal. (See *I.S.J.*, Vol. IX., 1907, pp. 45-49 and 102-105). A further Bulletin (No. 25) has lately appeared from the pen of Mr. C. F. Eckart containing supplementary information which goes to confirm the opinions already formed. The experiments now recorded were carried out on two crops from 14 plats in the station field, one being a ratoon and the other a plant crop. The plant cane was *Lahaina.*

Each plat consisted of four rows, 50 feet in length, the two middle rows forming the bases of the comparisons; one of these test rows was stripped and the other unstripped. Owing to the fact that they were immediately adjoining, the yields from these rows are comparable and the average results from the 14 plats afford positive conclusions with respect to stripping. Some fertilizer experiments undertaken simultaneously were, however, inconclusive, and only had the effect of varying the yields in different plats.

The results of the experiments, given in condensed form, were as follows:—

Weight of Cane.

	Tons per Acre. Stripped.	Tons per Acre. Not stripped.
Plant Cane	76·47	100·78
Ratoons	59·55	73·23
Average	68·01	87·00

SUCROSE IN JUICE.

	Per cent. Stripped.		Per cent. Not stripped.
Plant Cane	16·8	....	17·7
Ratoons	15·8	....	16·8

PURITY IN JUICE.

	Stripped.		Not stripped.
Plant Cane	89·3	....	90·3
Ratoons	87·0	....	88·0

AVAILABLE SUGAR.

	Tons per Acre. Stripped.		Tons per Acre. Not stripped.
Plant Cane	10·46	....	14·56
Ratoons	7·52	....	9·88
Average..	8·99	....	12·21

Mr. C. F. Eckart may well remark that "nothing in the way of an experiment could afford more convincing proof than these figures that stripping causes an enormous loss under such conditions as obtain at the Experiment Station."

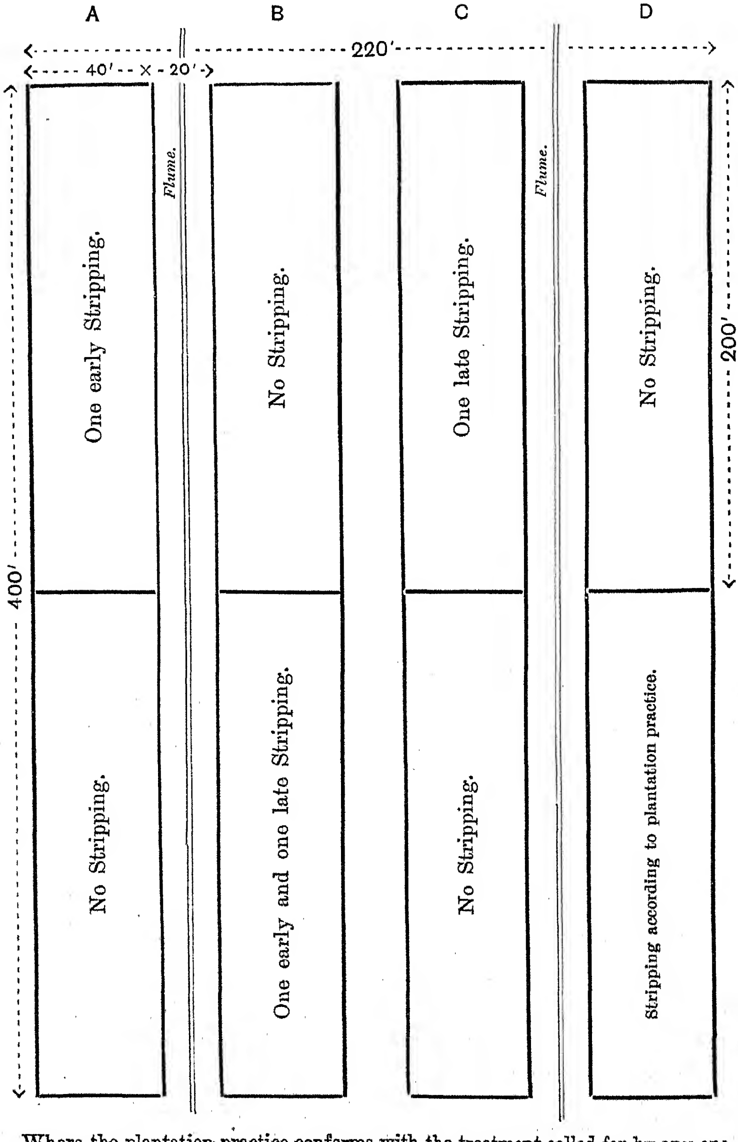
Most of the dead canes from the unstripped plots had died off when quite small, whereas where the canes was stripped dead sticks of all sizes, from young shoots to nearly mature stalks, were found. The number of such dead canes per acre was 7516 in the stripped plots, and 5519 in the unstripped ones.

Granting that the practice of removing dead leaves from canes results in anything like the loss recorded in these experiments, the total decrease in yields in all the Hawaiian cane fields must represent a very large sum. "If we could say that the average percentage of loss from stripping for the island of Oahu* was only one-half that at the Experiment Station, then the loss for last crop would have been approximately $1,210,350. This figure does not take into account the cost of stripping, but is based entirely on the yields of sugar. As far as I am able to learn, 323,800 tons of sugar were obtained from *stripped* cane on Hawaiian plantations from the crop of 1907. If the average percentage of loss from stripping was *one-third* of that experienced at the Station, this practice cost the plantations in sugar alone, for one year, nearly $3,000,000."

It is thus evident that stripping can have such a pronounced effect on the yields of sugar, that it is imperative all sugar growers should satisfy themselves by careful experiments that they are not losing an appreciable proportion of their crop by adhering to a very general custom. To this effect, the Hawaiian authorities recommend us to lay out experiment areas in accordance with the following diagrams which represent long narrow plats. The greater the length of the plats, the more accurate will be the results.

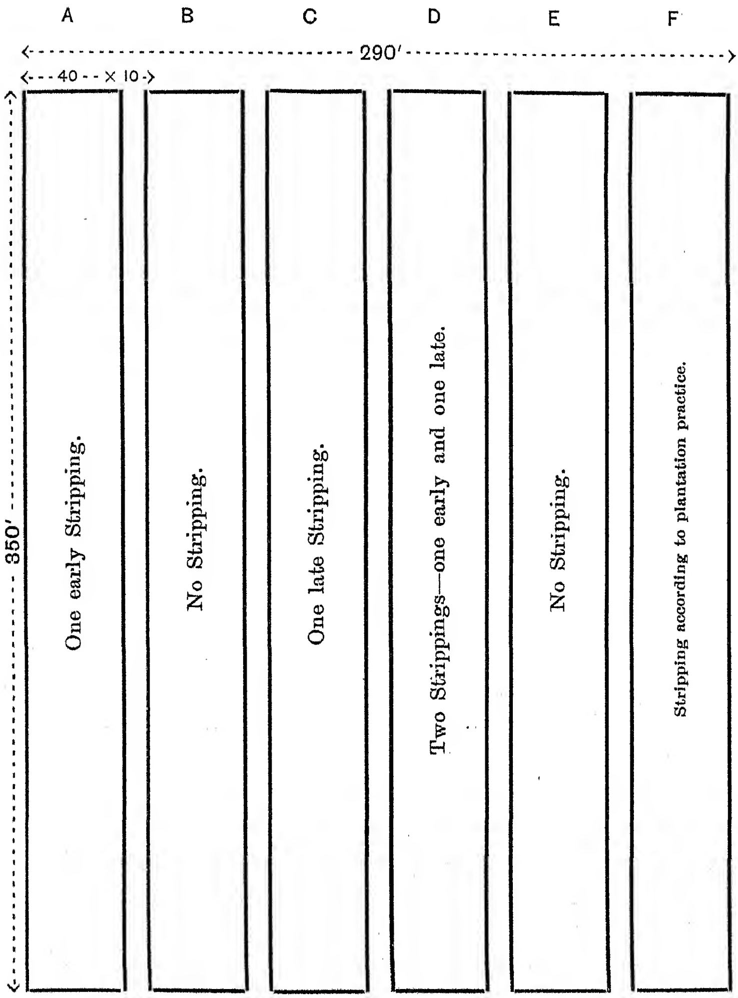
* 598 square miles.

EXPERIMENT FIELD FOR STRIPPING TESTS ON IRRIGATED PLANTATIONS.



Where the plantation practice conforms with the treatment called for by any one of Plats 1, 3 or 6, Plat 8 should be made a *three* stripping test.

EXPERIMENT FIELD FOR STRIPPING TESTS ON UNIRRIGATED PLANTATIONS.



Where the plantation practice conforms with the treatment called for by any one of Plats A, C or D, Plat F should be made a *three* strippings test.

NETHERLANDS.

The production of beetroot sugar in the Netherlands during the season 1907-08 was 175,000 tons, as against 181,000 tons in 1906-07 and 207,000 in 1905-06; the consumption for the 12 months ending August 31st, 1907, was 105,000 tons, as against 99,000 tons in 1905-06 and 90,000 tons in 1904-05.

Imports of Foreign Raw Sugar for Consumption, in 1000 Metric Tons:—

From	First 11 Months. 1906.	First 11 Months. 1907.	12 Months. 1905.	12 Months. 1906.
Dutch East Indies	0·2	0·1	0·2	0·2
Surinam	0·1	0·1	0·3	0·1
Belgium	33·9	66·8	30·1	34·2
Germany	8·8	9·4	34·2	8·8
United Kingdom	1·5	1·5	1·7	1·5
Other Countries	0·5	0·8	1·3	0·5
Total	45	78·7	67·8	45·3

The exports of raw and refined sugar were practically all destined for the United Kingdom. The figures for 1907 (11 months) were: Raw, 20,400 tons; Refined, 105,600 tons.

HUNGARY.

The following figures show the value of exports and imports of sugar during 1906:—

	Imports. £	Exports. £
General	400,280	1,472,000
To United Kingdom	—	118,628
,, British India	—	729,036
,, ,, Africa	—	453
,, ,, Mediterranean Possessions	—	37,978
,, ,, Red Sea ,,	—	11,174

JAVA.

As a result of a most favourable wet monsoon, the 1907 sugar crop exceeded in quantity the production of all previous years, and it is a matter for congratulation that, although the area under cane was considerably increased, the production per acre also proved to be the largest yet obtained.

The following figures show the production compared with 1906:—

		1906.	1907.
Planted area	Acres	260,810	281,750
Total production	Tons	1,046,691	1,144,383
Production per acre	,,	4·01	4·06
Mills working	Number	176	176

The chief factors which, under the propitious weather conditions above mentioned, helped to bring about this satisfactory state of affairs were the continuation of scientific systematic cultivation, the careful selection of the cane based on the experience of past years and the rational and frequent application of fertilizers coupled with the closest attention to the prevention of cane disease.

The experimental stations have again rendered valuable assistance both in improving the class of cane and in rendering it impervious to disease; it is stated that a new variety of cane has lately been discovered which will combine a prolific growth with a very high percentage of sugar.

The late breaking of the wet monsoon at the end of the year has hindered the growth of the 1908 crop, which, on this account, is likely to be later and less productive than that of 1907.

Exports of sugar for year ending December 31st, 1907, compared with the years 1905-06:—

Country.	Exports of Sugar. 1905. Tons.	1906. Tons.	1907. Tons.
United States	397,520	192,178	309,449
China	131,995	127,495	151,187
Japan	110,283	160,709	191,928
British India	83,328	111,527	311,569
United Kingdom	9,230	4,123	12,261
British Columbia	—	17,413	12,089
Australia	16,959	39,495	5,726
Continent of Europe	142	5,881	20,376
Other countries	70,266	60,906	44,083
Total	819,723	719,727	1,058,668

Hawaii.

The 1907 crop of sugar is reported by the Planters' Association to have amounted to 440,017 short tons, the largest crop the islands have ever produced. This output is divided among the islands as follows:—

	Short Tons.
Hawaii	143,891
Maui	104,772
Oahu	119,273
Kauai	72,081

The Italian sugar trade is making good progress, and shares are rising and dividends increasing. The industry is in the hands of three great societies—the Sugar Industry Society, the Liguria Lombard Refinery, and the Eridania.

Correspondence.

A MAURITIUS CANE.

To the Editor of the "International Sugar Journal."

Dear Sir,—In the April issue of the *International Sugar Journal*, an article on the Essential Mineral Constituents of the Sugar Cane by Mr. T. Murakami gives some analyses of different varieties of the cane. One of these canes is referred to as *Mauritius Bingham*. The term "Bingham" is, I take it, a distortion of the name Guingham; Delteil in his treatise *Le Canne à Sucre* gives *Guingham*, *Maillard* and Wray's *Otaheite Ribbon* cane as synonymous. The cane there described is the same as that now more generally known as *Striped Tanna* and in Hawaii as *Big Ribbon*. I call attention to this apparent case of name distortion in the hope of saving some future confusion in cane nomenclature.

Yours very truly,

Noël Deerr.

Honolulu, T. H., May 1st, 1908.

[We are glad to publish this correction: we find the word "Bingham" was a misprint for the author's "Gingham." However, even the latter was an unfamiliar name, but we were unable at the time to obtain confirmation of its accuracy.—*Ed. I.S.J.*]

ABSTRACTS, SCIENTIFIC AND TECHNICAL.*

Use of Sulphur Dioxide in Beetroot Sugar Manufacture. *G. Fouquet. Bull. Assoc. Chim., 1908, 25, 733-756.*

After the second carbonatation beetroot juices generally undergo treatment by reducing agents, the most generally used of these being sulphur dioxide.

Action of sulphur dioxide.—Decoloration is effected. A certain amount of organic substances and soluble lime salts are eliminated, consequently viscoscity is diminished and the syrups concentrate and crystallize more readily.

Quantity of sulphur dioxide to use.—Sulphur dioxide has no appreciable inverting action upon the sucrose of sugar liquors so long as they are alkaline to phenol-phthalein indicator; the presence, on the other hand, of free sulphur dioxide brings about inversion, the higher the temperature the greater being the amount of sugar destroyed. The question of the action of bisulphites is a more or less contested one; from his own practical experience the author believes that, at high temperatures, these have an inverting action, and that therefore

sulphitation should be carried only so far that normal sulphites are formed, *i.e.*, until the reaction is slightly alkaline or neutral to phenol-phthalein.

Method of Sulphuring.—Discussing the most economical and advantageous method of sulphuring, it is recommended that the juices should receive half the amount of sulphur dioxide required to neutralize its natural alkalinity, and that the rest should go to the syrups and after-products. The reasons given for this method of procedure are as follows: The juices, owing to their dilute condition, are more readily sulphited than the syrups; sulphited juices concentrate more readily than carbonated juices; the beneficial effects of the sulphites which are formed, continue during evaporation, an additional precipitation of organic substances and lime salts taking place; the juices are alkaline and danger of inversion is avoided; the syrups and after-products should be sulphured directly, for sulphur dioxide is a more energetic decolorizing and reducing agent than sulphites.

With regard to the sulphuring of the syrups and after-products, in which treatment is not so readily effected by sulphur dioxide, owing to their more concentrated state, the author recommends the use of Besson's powdered aluminium—tin alloy, which greatly facilitates the action of the gas, reacting with it to form nascent hydrogen, and forming a precipitate of aluminium hydroxide, which entrains a large amount of colouring and colloidal substances.

Control of sulphitation.—To determine the amount of sulphur dioxide introduced, a determination must be made by means of standard iodine, allowance being made for the quantity converted into sulphuric acid. The remaining alkalinity is best estimated by direct titration, using either rosolic acid or phenol-phthalein as indicator. In the case of bisulphites having been accidentally formed, the quantity is found by adding excess of standard alkali, then acid until neutrality is indicated by rosolic acid or phenol-phthalein, the difference between the two titrations representing the bisulphite present. Reliable indications with rosolic acid or phenol-phthalein are sometimes impossible when dark coloured liquids, such as after-products, are being operated upon; under such circumstances the best method is to determine the iodine titre and the alkalinity to litmus paper, 1 grm. SO_2 as neutral sulphite having an alkalinity to litmus equal to 0·33 grm. CaO; hence, the value for the real alkalinity is obtained if, from the alkalinity to litmus expressed in grms. per litre, one-third of the value for the amount of sulphur dioxide, similarly expressed, is deducted.

Use of liquid sulphur dioxide.—Liquid sulphur dioxide is recommended on the grounds that sulphur-furnaces, of whatever type they may be, are liable to certain objections, and that, moreover, it is difficult to obtain by them a gas quite free from sulphuric acid. Sulphitation may be very accurately regulated by a Paconnett

sulphometer (*Bull. Assoc. Chim.*, 1907, 24, 1660). The volume of the juice in the heater and the degree of sulphitation to be effected being known, the necessary amount of sulphur dioxide is measured in the sulphometer, which is then disconnected from the cylinder and its contents gradually passed into the juice, a proper mixing being assisted by a revolving distributor provided with arms arranged in helix form. When sulphitation is continuous, a regular flow of gas may be obtained if, between the valve of the cylinder and the pipe leading to the sulphiting tank, a small vessel, capable of being heated from time to time to allow of the expansion of the gas, is interposed.

Sulphitation of sugar juices has been often condemned by reason of the incrustations which form on the heating surfaces of the multiple effect, but these deposits, the author points out, will not occur if carbonatation is continued until there is no longer any free lime in solution.

SIMPLE METHOD FOR THE DETERMINATION OF THE ALCOHOL CONTENT OF DISTILLERY WASHES. *B. Wagner, F. Schultz, and J. Rüb. Chem. Zeit., 1908, 32, 297-298.*

The proposed method consists in determining, by means of a Zeiss immersion refractometer, the refractive index of the wash before and after evaporating off the alcohol contained in it. The sample is "tossed" to expel carbon dioxide and, after standing for a short time, 25-30 cc. are filtered off. 5-10 cc. of this amount are examined in the refractometer; 20 cc. are evaporated down to half bulk, made up again to 20 cc., and the refractive index determined at the same temperature as the first. To the difference between the two readings is added the value for the refractive index of water at the temperature used; by then referring to the tables given, the alcohol content is readily obtained.

This method is quicker than those based on specific gravity determinations and is, it is claimed by the authors, more accurate.

USE OF HYDROSULPHITE IN BEET SUGAR MANUFACTURE. *C. Rytel. Centr. Zuckerind., 16, 67-69.*

After having used "Blankit" (sodium hydrosulphite) in the diffusion batteries in the first, second and third saturation juices, and in the vacuum pans, the author thus summarizes the results he obtained: Decolorization takes place almost instantly. The various colouring matters are not affected in the same degree, and on some, such as caramel and a yellow pigment found in the beet, the bleaching material has no action. The best results were obtained in the vacuum pan; the "Blankit" is best introduced into the pan in the powdered form; if dissolved in water the results obtained are not as good, even when the solution is used without delay. The alkalinity of the juice influences the efficiency of the material, the greater the alkalinity, the less discoloration being obtained. The

quantities (on weight of dry substance) of "Blankit" recommended are, for the first saturation 0·14-0·16 per cent., for the third saturation 0·036-0·042 per cent., and for the masse-cuite 0·0096 per cent· Further experiments showed the use of the calcium salt to be unsatisfactory, the decolorization not being permanent and the sugar having a yellowish colour.

Experiments on the Reducing Power of Sodium Hydrosulphite. *F. Driessen.* *Industrial Gesellschaft Mülhausen*, through *Chem. Zeit.*, *1908*, *32*, *449.*

The reducing power of sodium hydrosulphite is much higher whilst the salt is passing into solution, *in statu solvendi*, than when in solution. This may be readily proved by two simple comparative experiments: (*a*) 50 mgrm. of sodium hydrosulphite and 15 cc. of alcohol are mixed together in a dry test tube, heated to boiling, and a piece of cotton dyed with indigo placed in the liquid; 5 cc. of water are next added and heating continued for a little time longer. (*b*) 50 mgrm. of sodium hydrosulphite are dissolved in 5 cc. of water, 15 cc. of alcohol, and the indigo dyed fibre added, and the mixture then boiled.

In the first experiment the blue colour is readily and completely discharged, but on continued boiling it reappears at the moment when all the hydrosulphite has passed into solution; sulphuretted hydrogen, moreover, is evolved during boiling. In the second experiment the colour is not discharged, and sulphur dioxide is given off when the mixture is boiled.

Estimation of Potash in Soils, Manures, &c., by the Perchloric Acid Method. *V. Schenke.* *Landw. Versuchs. Stat.* through *Chem. Central.*, *1908*, *1423-1424.*

The sulphuric acid solution of the substance is evaporated to dryness and ignited, at first gently, then at a low red heat. The residue is extracted with hot water, being repeatedly rubbed, and with 2-3 cc. of 5 per cent. hydrochloric acid. After having washed the liquid into a measuring flask, barium chloride is added to precipitate the sulphuric acid, only a very slight excess of the reagent being used. If the amount of precipitate is small it is unnecessary to filter the solution. A drop or two of phenol-phthalein solution is added, then milk-of-lime, until the presence of a slight excess is shown by the indicator. An aliquot portion of the liquid is taken after half an hour, acidulated with hydrochloric acid, evaporated to a small bulk, then the potash in it determined by the perchloric acid method in the usual way.

The results obtained by this process agree well with those determined by the ammonia and ammonium carbonate modification.

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. Thompson, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; and 322, High Holborn, London.

ENGLISH.—Applications.

7813. A. J. Boult, London. (Communicated by Fin Sparre, United States.) *Process for the production of products in addition to alcohol by fermentation of saccharine solutions, preferably maltose.* (Complete specification.) 8th April, 1908.

8366. R. O. Vargas, London. *Apparatus for the extraction or removal of powdered sugar from the centrifugals employed in the manufacture of sugar.* (Date applied for under Section 91 of the Act, 30th November, 1907, being date of application in Spain.) (Complete specification.) 15th April, 1908.

Abridgment.

18549. P. Bévenot, Paris, France. *Improvements in apparatus for the extraction and desiccation of the solid parts contained in natural fluids or in solutions and particularly for the production of milk powder and the extraction of sugar from saccharine juices.* 16th August, 1907. This invention relates to apparatus for the extraction and desiccation of the solid parts contained in natural fluids or in solutions and particularly for the production of milk powder and the extraction of sugar from saccharine juices of the character described in my former specification No. 28767, 1906, the reversal of the current of hot air by causing it to enter at the upper part of the atomizing chamber and to descend through said chamber to the lower part thereof where it enters flues near to the receiving hopper which flues rise to and are continued under the flooring of the expansion chamber where they are connected to a fixed drum.

GERMAN.—Abridgments.

195035. Ferdinand Bing, of Stavanger, Norway. *A process and apparatus for re-disintegrating potato shreddings, maize mash, and the like.* May 12th, 1907. The process consists in the shreddings being again disintegrated in a dehydrated compressed condition. The apparatus for carrying out this process comprises a dehydrating machine composed in the usual way of a cylindrical sieve and a compressing worm, by means of which apparatus the dehydrated shreddings are pressed against a disintegrating drum by means of a recessed friction block provided at the discharge end.

195071. Sylvester Godlewski, of the Sugar Works, Guzow, near Zyrardow, Russian Poland. *A vacuum boiling-down apparatus with multiple effect.* 9th March, 1906. This apparatus is characterized

by several compartments arranged one above the other, over the corrugated floors of which compartments the juice to be evaporated flows from below upwards, the first compartment from below being heated by the admission of steam and each succeeding compartment by the vapour from the juice, which vapour has been formed in the next lower compartment.

195072. MAX GOLLMERT, of Schöneberg, near Berlin. *A process for the enzymatic dividing of raffinose and products containing raffinose.* 5th August, 1906. In this process the raffinose is converted into cane sugar and lactose by the action of emulsin or substances containing emulsin or enzyme having a similar action.

195694. Dr. JEAN EFFRONT, Brussels. *A process for purifying beetroot juice.* 19th December, 1906. This process consists in subjecting beetroot juice to the mutual action of yeast and mineral acid at a temperature of from 55-65°.

195740. JULES CHARLES FERNAND LAFEUILLE, of Chateau de Quessy, near Verguier Aisne. *A process and apparatus for drying beetroot shreddings in particular in a revoluble drum.* October 10th, 1906. The process consists in the hot air being conducted to the shreddings at the end at which they enter, both axially as well as radially from outside and inside into the drum. The apparatus for carrying out this process comprises two revoluble drums one inserted inside the other, the outer drum being only perforated at the admission end in a certain portion of its chamber, but the internal drum which is located eccentrically to the external drum is entirely perforated in the part between the end walls and is provided with two rows of holes separated by a plate and has in its interior one or more partitions which only have apertures of passage at the periphery of the drum.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of April, 1907 and 1908.

IMPORTS.

Raw Sugars.	Quantities. 1907. Cwts.	Quantities. 1908. Cwts.	Values. 1907. £	Values. 1908. £
Germany	2,968,203	2,578,630	1,353,679	1,330,250
Holland	57,823	86,594	24,259	42,293
Belgium	147,979	52,879	63,749	25,810
France	90,705	55,513	43,730	31,768
Austria-Hungary	246,543	356,795	110,787	190,606
Java	64,194	291,323	33,230	161,355
Philippine Islands	19,569	35	8,500	15
Cuba	91,092	....	39,590	....
Peru	132,371	424,227	60,824	225,623
Brazil	182,391	1,612	75,239	728
Argentine Republic	....	....	....	....
Mauritius	147,287	222,541	62,678	98,518
British East Indies	....	20,491	..	8,368
Straits Settlements	57,174	60,237	24,610	26,468
Br. W. Indies, Guiana, &c.	553,024	419,182	325,585	295,374
Other Countries	346,287	311,046	169,957	172,272
Total Raw Sugars	5,104,642	4,881,105	2,396,417	2,609,448
Refined Sugars.				
Germany	3,829,167	4,428,041	2,228,117	2,770,406
Holland	938,230	828,607	581,855	550,428
Belgium	87,112	65,518	52,931	41,433
France	847,899	434,233	486,305	276,252
Other Countries	457	22,529	349	14,282
Total Refined Sugars	5,702,865	5,778,928	3,349,557	3,652,801
Molasses	852,614	821,111	166,211	161,125
Total Imports	11,660,121	11,481,144	5,912,185	6,423,374

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	178	528	116	211
Norway	5,198	3,256	3,069	2,084
Denmark	33,572	26,384	17,336	14,875
Holland	24,541	22,800	16,091	16,133
Belgium	3,054	2,626	1,810	1,794
Portugal, Azores, &c.	11,910	5,251	6,467	3,115
Italy	8,015	3,468	4,181	2,030
Other Countries	108,762	68,206	79,977	53,356
	195,230	132,519	129,047	93,598
Foreign & Colonial Sugars				
Refined and Candy	4,298	4,596	3,202	3,516
Unrefined	20,740	26,343	11,640	16,295
Molasses	1,525	238	417	77
Total Exports	221,793	163,696	144,306	113,486

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1908. Tons.		1907. Tons.
Total Receipts Jan. 1st to May 14th ..	832,897	..	883,753
Receipts of Refined ,, ,, ...	510	..	405
Deliveries ,, ,, ...	831,809	..	842,306
Importers' Stocks, May 13th	6,708	..	41,447
Total Stocks, May 27th	331,000	..	372,820
Stocks in Cuba, ,, ...	149,000	..	369,000
	1907.		1906.
Total Consumption for twelve months..	2,993,979	..	2,864,013

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1907 AND 1908.

(Tons of 2,240lbs.)	1907. Tons.		1908. Tons.
Exports	753,057	..	574,910
Stocks	462,480	..	239,217
	1,215,537	..	814,127
Local Consumption (4 months)	16,250	..	19,640
	1,231,787	..	833,767
Stock on 1st January (old crop)	....	..	9,318
Receipts at Ports up to April 30th	1,231,787	..	824,449

Havana, April 30th, 1908. J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR FOUR MONTHS, ENDING APRIL 30TH, 1908.

SUGAR.	IMPORTS. 1906. Tons.	1907. Tons.	1908. Tons.	EXPORTS (Foreign). 1906. Tons.	1907. Tons.	1908. Tons.
Refined	262,400	285,143	288,946	408	215	230
Raw	282,225	255,232	244,055	4,309	1,037	1,317
Molasses	41,708	42,631	41,055	239	76	12
Total	586,333	583,006	574,056	4,956	1,328	1,559

	HOME CONSUMPTION. 1906. Tons.	1907. Tons.	1908. Tons.
Refined	244,935	268,436	255,534
Refined (in Bond) in the United Kingdom	178,962	162,773	165,383
Raw	36,670	29,456	34,727
Molasses	40,895	38,681	41,443
Molasses, manufactured (in Bond) in U.K.	23,103	24,812	25,166
Total	524,565	524,158	522,253
Less Exports of British Refined	15,041	9,761	6,626
Total Home Consumption of Sugar	509,524	514,397	515,627

Stocks of Sugar in Europe at uneven dates, May 1st to 23rd. compared with previous Years.

In thousands of tons, to the nearest thousand.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	Total 1908.
111	910	456	594	153	2324

	1907.	1906.	1905.	1904.
Totals	2445 ..	2810 ..	2002 ..	2546

Twelve Months' Consumption of Sugar in Europe for Three Years, ending April 30th, in thousands of tons.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria-Hungary	Holland, Belgium, &c.	Total 1907-08.	Total 1906-07.	Total 1905-06.
1907	1176	654	550	201	4472	4481	4003

Estimated Crop of Beetroot Sugar on the Continent of Europe for the current Campaign, compared with the actual crop of the three previous Campaigns.

(From Licht's Monthly Circular.)

	1907-1908.	1906-1907.	1905-1906.	1904-1905.
	Tons.	Tons.	Tons.	Tons.
Germany	2,132,000 ..	2,239,179 ..	2,418,156 ..	1,598,164
Austria	1,430,000 ..	1,343,940 ..	1,509,789 ..	889,431
France	725,000 ..	756,094 ..	1,089,684 ..	622,422
Russia	1,410,000 ..	1,440,130 ..	968,500 ..	953,626
Belgium	235,000 ..	282,804 ..	328,770 ..	176,466
Holland	175,000 ..	181,417 ..	207,189 ..	136,551
Other Countries .	435,000 ..	467,244 ..	410,255 ..	332,098
	6,542,000	6,710,808	6,932,343	4,708,758

THE
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☞ All communications to be addressed to the Editor, Office of "The Sugar Cane," Altrincham, near Manchester.

All Advertisements to be sent direct.

Cheques and Postal Orders to be made payable to NORMAN RODGER, Altrincham.

The Editor will be glad to consider any MSS. sent to him for insertion in this Journal and will endeavour to return the same if unsuitable; but he cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTICE TO READERS.—If the Advertisement pages stick together, bang their edges on the table, when they should easily separate.

NOTES AND COMMENTS.

The Russian Stock of Sugar.

We read as follows in the *Journal des Fabricants de Sucre* of the 10th of June:—

"Russia.—The stock of sugar, not including the compulsory reserve, was (expressed in raw sugar) on the 1/14 May, 1908,
537,776 tons
against 595,369 tons on the same date of May, 1907,
and 239,693 tons last September."

If the stock of 595,369 tons on the 1/14 May, 1907, fell to 239,693 tons on the 1st September it must be concluded that the smaller stock of 537,776 tons existing on the 1/14 May this year will fall in much the same way. That being so, what becomes of the universal outcry that the stocks in Russia, owing to the recent prolific crops, would increase to such an extent as to amount to more than 500,000 tons on the 1st September, 1908? We think we have seen this stated, not only in the sugar journals and trade circulars, but even in official reports. The natural inference was that the figure representing what is called the "free sugar stock" in Russia did not include the stocks in the factories of their "contingents" for home consumption. If the paragraph quoted above is correct this is not the case, and all

the very definite and persistent reports as to the great accumulation of sugar in excess of that required for home consumption are completely unfounded. As we have been grievously misled by those most circumstantial reports, and have based important inferences upon them, we hasten to point out the great discrepancy between what is now stated and that which was previously accepted as representing the facts of the case.

The 1908-09 Sugar Production.

Speculation is rife as to the extent of the sugar production of 1908-09. Otto Licht recently estimated the cane crop to be an increase of 615,000 tons over the amount for 1907-08; but he afterwards reduced this figure to 235,000 tons. The German General Assembly of Sugar Manufacturers at a recent meeting presumed the excess of cane sugar over the preceding year would be no more than 200,000 tons. On the other hand Licht considered that if the new beet crop had a *rendement* equal to that of 1907-08, there would be a deficit of 200,000 tons for Europe. Thus, according to Sachs, the 1908-09 campaign may not exceed in output the present one, which is already known to be deficient.

Penny Postage with the United States.

A welcome if somewhat unexpected announcement was made last month to the effect that the Postmasters-General of the United Kingdom and United States respectively had concluded an agreement by which the postage on letters between this country and the States would be reduced on and after October 1st next to the rate of 1d. per ounce instead of 2½d. as at present. This reduction comes as a boon to all classes of the community, but specially to that section of the commercial world which has an extensive business connection with the United States. If, as we presume, Porto Rico and the Hawaiian Islands are included in the agreement, a very considerable saving in postage should result to many of our readers both in those countries and at home. As far as we are concerned, our hope is that the cheaper rate will tend to bring us into more frequent contact with our numerous American correspondents than has so far been the case. Both nations stand to gain by an increased exchange of communications, as the more frequently they inter-correspond, the better they will get to understand one another. It is to be regretted that attempts which have been made to secure similar preferential postage between England and France have so far failed, owing, it is said, to a *non possumus* on the part of the British Government. So we must continue to put up with the anomaly of paying 2½d. for a letter sent from London to Paris, while a letter from London to Fiji, some 10,000 miles away, costs only one penny.

Mr. H. C. Prinsen Geerligs.

We learn that the Java Sugar Experiment Station has established a branch office in Amsterdam (Wanningstraat 17) which will be under the supervision of Mr. H. C. Prinsen Geerligs, who has just left the Pekalongan branch of the same Station. The chief work of the Amsterdam office will be to give advice to those proprietors and shareholders of Java sugar estates who reside in Holland. But in addition to that, Mr. Prinsen Geerligs proposes to keep up his connection with the scientific side of sugar production and manufacture, and we hope that he will continue a regular and valued contributor to our columns as he has been throughout the past 16 years.

Mr. Gibson Bowles on Free Trade.

A long and rather violent letter appeared in the *Times* of June 6th from Mr. Gibson Bowles, attacking the Government for the part they had taken in the renewal of the Sugar Convention. The principle underlying this thorny question being the definition of Free Trade, Mr. Bowles naturally devoted himself to proving that the Government's action was antagonistic to the old creed. His letter produced a short but concise reply from Sir Nevile Lubbock who laid down the only logical definition of the case. His argument was as follows :—

"1. The producers of sugar in the world may be divided into two classes: (*a*) those who are subsidized in some form or other, and (*b*) those who received no subsidy or artificial assistance whatever. 2. The battleground of these parties is practically the British market. 3. It is absolutely certain that in such a competition the unsubsidized competitor must go to the wall.

"Now it is fairly obvious that the subsidized competitor would not have received a subsidy if he could produce more cheaply and thus naturally undersell his unsubsidized competitor. His production is obviously more costly than the other. Hence, if these conditions are left alone, the result must be, and, in fact, has been, that in British markets the more costly product is substituted for the less costly, and the unsubsidized British producer is ousted from the British markets by the more costly foreign producer, who, by means of Government subsidies, has been able to undersell him.

"Mr. Bowles calls this Free Trade! Does Lord Cromer agree with him?"

The Austrian Excise Tax on Sugar.

The Austrian Reichsrat lately had before them the question of reducing the sugar tax by 8 crowns per centner; but the Budget Committee of their Upper House rejected the proposal, after it had been passed by the Lower House who acted in defiance of the recommendation of the Finance Minister. The reason for this rejection is

said to be that the expenditure of the Austrian State will be too great in the near future to allow the receipts from taxes being reduced 28,000,000 crowns per year. So what would have proved an excellent inducement to increased home consumption in Austria is foiled by national expenses in connection with the services and railways. It is clear however that the Austrians are waking to the fact that their sugar is still a long way too dear.

THE NEW SUGAR CONVENTION AND THE GOVERNMENT.

On Wednesday, the 3rd June, an occasion was afforded, on the motion for adjournment for the Whitsuntide holidays, for a brief debate on the policy of the Government in modifying instead of denouncing the Brussels Convention. Mr. Villiers, who poses as an enthusiastic free-trader, repeated all the old and exploded fallacies as to the past, present and future effects of that international arrangement. In spite of the complete refutation which has so repeatedly been given to all the erroneous assertions of the opponents of a measure which has abolished the protection of foreign producers in British markets and restored free trade in sugar, Mr. Villiers did not hesitate once more to declare that this agreement had limited our supply of sugar, and thereby raised the price; that it subjected our legislation to the dictation of foreign delegates; that it increased instead of diminishing fluctuations in the market; that the West Indies had produced less instead of more sugar; that sugar was cheaper in the other contracting States; that refining in bond cost the country a large annual sum, and injured the smaller manufacturers; that the enormous stock of 50,000 tons (!) had accumulated in Russia in the course of five years, owing to our prohibition of Russian sugar; that the only modification now introduced into the Convention was that the importation of Russian sugar, instead of being prohibited was now only limited; that "the results of the Convention had been disastrous to this country," but that "he would not argue that point;" that "as a matter of fact it had not abolished bounties at all;" and that, finally, "it was not for us to teach other countries their business, more especially when we benefited by their errors."

Mr. Villiers is evidently not well posted up in the facts, otherwise he would know that the Convention has not limited our supply of sugar. We consume 1,600,000 tons of sugar, and we have 10,000,000 tons from which we can select our supplies. Until this year Russia has had no sugar to spare for us. He is unaware that, far from our having been subjected to the dictation of foreign delegates, our delegate has carried, with one exception, *every point* which he has

raised up to the end of last year. The great fluctuation in the market in 1904-5 was the result, not of the Convention but of the bounties. Bounties had caused the European beetroot sugar production to increase until at one time it constituted more than two-thirds of the visible production of the world. Therefore whenever there is a deficient beetroot crop there is a great rise in the price of sugar. This is one of the evil effects of disturbing the natural course of production by the giving of artificial advantages. There was a deficiency in the European crop of 1904 which suddenly deprived the world of 1,200,000 tons of sugar, and naturally the market went up. Mr. Villiers does not hesitate, in the face of this explanation, to repeat the electioneering "inexactitude" that the great rise in price in 1904-5 was caused by the Convention. He does not know that the West Indies have had some deficient crops since 1903, so he jumps to the conclusion that the Convention has done them no good. The old story that the price of sugar has gone down on the Continent he is glad to repeat, not being aware that continental prices and our prices are identical. To the consumer of course they vary with the varying rates of duty. Any stock of sugar which has accumulated in Russia is owing to abnormally prolific crops during the last two years. Mr. Villiers says it is 50,000 tons. That is his idea of the loss we have suffered by the prohibition of Russian sugar. That loss of 50,000 tons was, in his opinion, the cause of the great rise in the price of sugar; not the fact that Europe produced 1,200,000 tons less than was expected. It is a pity that members of Parliament do not try to acquire a few rudimentary facts when dealing with great questions of political economy.

Mr. Villiers' only real grievance is that the Government have substituted limitation of imports for prohibition. Russia is practically the only country whose sugar was prohibited under the penal clause of the Convention. We have it recorded officially that our annual importation of Russian sugar could not have exceeded 40,000 tons. We know that since 1903 Russia has had no sugar to spare till now. Under the new arrangement Russia is permitted to send to us 300,000 tons next September, and 200,000 tons every following year during the continuance of the Convention. That is, Russia can send to us five times as much sugar as she ever did before. This is the only real complaint which Mr. Villiers has against the Government—limitation of imports.

His last three points are the most striking of all. He will not tell us why the Convention has been "disastrous to this country," nor does he explain how "as a matter of fact it has not abolished bounties at all." Those who are engaged in the sugar industry on the Continent would be surprised to hear of that discovery. It is only at the last moment that Mr. Villiers mentions the real genuine reason for his zeal for free trade. He thinks we ought not to object to

bounty-fed competition because we benefit by it. He believes, evidently, that to cripple and distress a natural industry by stimulating artificially an unnatural competition is a benefit to the consumer. He prefers that arrangement, with reduced supplies, high prices, and a gradual monopoly, to the ordinary course of unfettered competition. And this he calls Free Trade.

It is refreshing to turn to the speech of his supporter, Mr. Austin Taylor, member for the East Toxteth division of Liverpool, who made a really brilliant attack on the Government. We give the following extract as a specimen :—

He thought they were indebted to the Government for introducing a vein of humour into this somewhat ponderous international arrangement. Could the House imagine anything more humorous than for this country to say to the sugar-producing countries of the Continent, "Yes, we are with you in your desire to suppress bounties. We shall go upon the Permanent Commission and pay our due share of the expenses, and we shall receive from our delegate the reports which the Commission collects upon the various fiscal systems of the sugar-producing countries of the globe. But when you ask us to penalize or prohibit this bounty-fed sugar, we join issue, and say the severest punishment we can inflict is to admit as much of it as we can get." It was as though one were to join a syndicate of detectives for searching out burglars, and when they had been detected, solemnly to inform one's colleagues that the only thing one could do by way of punishment was to become the receiver of the stolen goods. Of course, the sugar-producing countries did not take this action of the Government lying down. They were in rather a delicate position, because, while passing a self-denying ordinance, to which we were parties, that they would not impose a surtax beyond six francs per 100 k. on sugar, they found that we were prepared to admit any country that was able with bounty-fed sugar to raid the English market. Germany looked round and found that the really serious potential competitor in bounty-fed sugar was Russia. There were great possibilities of sugar cultivation in that country. Labour was cheaper than in Germany, and it was difficult to say to what extent Russia might have gone had she been left free to pour into the English market all the bounty-fed sugar she could produce. . . . It was, therefore, essential that the sugar-producing members of the Convention should disarm Russia as far as possible. In fact, their policy, stimulated by our attitude, was to secure that outside the Convention there should be as few potential burglars of the English market as possible, and as Russia was the chief cause of suspicion German efforts were directed to securing the restriction of her export. . . . . He did not know what effect that had on the mind of the Secretary of State for Foreign Affairs, but he adopted the attitude that

this was a matter between the sugar-producing countries and Russia, and one with which we had no concern. Yet it was our action, and our action alone, in continuing members of the Convention, while deciding to take bounty-fed sugar wherever we could get it, which impelled the sugar-producing countries to secure the burglars and turn them into policemen as rapidly as possible. Our delegate at Brussels, Sir Henry Bergne, must surely have found himself in an extraordinary position. He was *vis-à-vis* with the sugar-producing States of the Continent, whose desire was to suppress bounty-fed sugar, and he represented a country which said to them, "We are with you up to a point, but we wish to receive the thing which you desire to destroy."

The only other speaker in opposition to the Convention was our old friend Mr. Lough. We well know by this time his style—loose, inaccurate, erroneous, misleading—often mingled with statements devoid of any foundation. Wrong figures, wrong words, wandering and inconclusive argument, violent denunciation. Those who aspire to be statesmen, as Mr. Lough did for a brief space, must in the first place learn to be lucid, accurate and concise. In these respects Mr. Lough has conspicuously failed, and this last of his appearances as a political economist is probably the most deplorable of all.

Sir Edward Grey's speech (a resumé of which will be found on another page) was excellent. He defended the policy adopted by the Government with great skill and considerable force. We heartily congratulate him on getting so well out of a very awkward position, and on the remarkable ability shown by those who had to conduct the negotiations.

Mr. Mitchell-Thomson wound up the debate with a few words of truth, common sense, and sound reasoning.

A GERMAN VIEW OF THE COMMONS DEBATE.

The debate in the House of Commons on the sugar question, on June 3rd, attracted more than the usual amount of attention on the Continent, and the leading German sugar organ, the *Deutsche Zuckerindustrie*, considered the whole of Sir Edward Grey's spirited reply worth while reproducing in its columns. Our contemporary had also some pertinent remarks to make on the subject, which revealed such an accurate grasp of the situation that we think we cannot do better than quote them in extenso.

After referring to the events which led up to the debate and explaining the political reasons which had prevented the malcontents from raising the question earlier in the session, the *D. Z. I.* proceeds as follows:—

"It is remarkable in a country governed as England is by Parliamentary institutions, that the Government had not thought it worth while to obtain the assent of Parliament before ratifying the continuance of the Brussels Convention, and accordingly the assailants of the Government renewed the reproach which had already been levelled at it, that it had not taken the House into its confidence, reminding Ministers of the promises made during the electoral campaign that an end should be put to the much-abused Convention at the first favourable opportunity. Promises to that effect had been solemnly made, in the event of their being elected, by at least twenty members now sitting on the Treasury benches, and little surprise can be felt at the rumours pervading the House that the Government was no longer adhering to the genuine old principles of Free Trade, and that the 'Free Breakfast Table' was to be offered up as a sacrifice to the Entente Cordiale.

"Truly Radical Free Traders are not letting slip the occasion to set their devotion to the principles of Free Trade in a right light. But in the carrying out of their Free Trade views in the sugar question, they are forced into inconsistencies. Just as Cobden in the endeavour to attain his ultimate aim was obliged to have recourse to a means so little consonant with Free Trade views as a treaty of commerce, so his followers are forced to seek support in measures involving protective tariffs, as the 'most favoured nation' clause does. And hence they can get this support readily from the Secretary of State for Foreign Affairs, who is wont to estimate these matters by a practical standard, and hence prohibitive or protective duties are by no means irreconcilable with the 'most favoured nation' clause, to say nothing of the famous White Book 'Commercial,' No. 1 (1903); and hence also the admissibility of prohibitive or protective duties, specially in reference to Russia, was quite definitely defended by an English, though certainly a Conservative, Government. Equally illusory was the contention of Mr. Lough, a former member of the administration, that Free Trade and bounties so far counterbalance each other that the effect of protective duties was nullified by bounties. Be it said *en passant* that it is the exact opposite in the case of sugar, in which bounties, so far from softening them, have intensified the effect of protective duties. As a matter of fact, the working of protective duties could only be weakened by a bounty system to the extent by which the protective duties of one country were exceeded by the bounties granted by another. Indeed, if the theoretical attacks of English Free Traders will not bear careful examination, still less will their practical position do so. The arguments, based upon prices, of such a man as Mr. Lough, have only to be heard to enable the ridiculousness of the position of English Free Traders to become evident. Exactly as the Brussels Convention long ago was made responsible for the rise in prices which followed a

deficient European beet crop, so now the Convention is blamed because consumers have to pay higher prices owing to the falling off in the Cuban crop.

"The most important contribution to the debate was that of Sir E. Grey, the Secretary of State for Foreign Affairs. His speech, however unpremeditated it may have been, forms one of the most interesting documents which have appeared in recent years on the sugar question. It shows the statesman estimating circumstances, not in accordance with the measure of theoretical party-phrases, but as they are in fact, although for reasons we can easily understand he utters no word on the political interests, so much discussed nowadays, which have influenced the position taken up by the Government.

"The speech shows that the position of Germany in the whole matter is not so weak as unfortunately it has been frequently said to be in this country. On the contrary, if the situation were more decidedly utilised, the words of the English Minister for Foreign Affairs leave no doubt that not only would all be attained that is now attained, but that, moreover—as regards England also—a completely free hand would be gained, whereas, as it is, England will take care (as Sir E. Grey's hint to Italy bears striking witness) to meet all steps taken in the interests of Continental sugar-exporters."

SIR EDWARD GREY ON THE SUGAR CONVENTION.

On June 3rd the opponents of the Sugar Convention seized the opportunity presented by the motion for adjournment for Whitsuntide to start a debate on the Sugar Convention.

The discussion was opened by Mr. Villiers, who charged the Government with renewing a Convention which violated free trade principles. He was supported by Mr. Austin Taylor, a former Unionist, who strongly questioned the wisdom of the Government's action.

The chief interest naturally centred round the speech of Sir Edward Grey, who defended the Government of which he was a member. He began by complimenting Mr. Austin Taylor on his staunch support of free trade principles, but claimed that the Government had in effect considered the free trade aspect of the measure, inasmuch as they had secured a large amount of complete liberty for the receipt of bounty fed sugar in our ports. The two Conventions were technically the same, but as a matter of fact the arguments which applied to the denunciation of the old Convention were almost all of them met by the alterations which had been introduced into the present Convention.

He pointed out that while the fiscal principles of the Convention entered into by the late Unionist Government were at variance

with the free trade views of his own Government, there was the case of the other countries parties to the agreement that had to be considered, and we were bound to consider the engagements taken by them, and the moral claims which those countries could put forward in consequence of the previous action of this country. The Government's view was that the Convention as it existed was one which they could not continue, and which they must denounce at the earliest possible moment. But the effect of giving such notice was to draw forth from the other participants a courteous but perfectly clear intimation that this proposal of ours was meting out rather hard treatment to them and putting them to considerable inconvenience. "Their point was that the British Government had taken a leading part in inducing them to enter into the Convention, and that in entering into that Convention they had had to remodel their own fiscal system. They had altered their duties, abolished their bounties, got rid of their cartels, got rid of the old complicated system which they endured for many years, and built up with a great deal of ingenuity and trouble, and embarked upon an entirely new fiscal system which had then lasted for four years, and they had done that, it is not too much to say in some instances, under pressure from this country. And they said to us—'You, the British Government, having done this, now, at the earliest possible moment, are going to upset the whole arrangement by putting us to the exceeding inconvenience of having to reconsider the whole position, which you yourselves were in the first instance one of the most influential in bringing about.' That would not have weighed with us as against the economic interests of this country if we had considered the economic interests seriously involved, and we held to our position that if the old Convention was to stand we must denounce it at the earliest possible moment." *

But it was untrue, in Sir E. Grey's opinion, to suppose that the old state of things, so beneficial to this country according to his critics, would return if the Convention had been broken up. The other countries would have made a probably successful attempt to continue the Convention without us, as they were not anxious to revert to the bounty system once more. They would have induced Russia to join them, and with the United Kingdom left out of it, her sugar exports would have been subjected to prohibitive or retaliatory duties imposed by the participating States. Even if the economic effect of this was doubtful, the political effect would have been prejudicial. It would, to say the least, have created certain friction and have adversely affected the political atmosphere, thus making international relations more difficult. And it was a mistake to suppose that the most-favoured-nation clause would necessarily have prevented the levying of such duties on bountied sugar or sugar goods. The clause had always answered so

* For this and the subsequent extracts we are indebted to the report in *The Times*.

far, but in an exceptional case like this its interpretation might be disputed.

Their real objection, however, was to the penal clause, and, as they told the House a year previously, they were prepared to continue parties to the Convention if freed from this clause. As then the other nations showed their willingness to so free them, the Government felt it was only reasonable that we should meet them by continuing parties to the measure as altered. So we agreed.

The other parties made it a condition that Russia should join the Convention, and though Great Britain had previously been unwilling that Russia with her then existing system should become a party, her objections were removed with the disappearance of the penal clause in her case, and the Government therefore said they would be glad to see Russia join the Convention. But the other Powers were aware of the risk to which this would expose them in our market, and they said that either the Russian fiscal system must be altered or some limitations be placed on the exports of Russian sugar. We might have demurred, but as, however, we were not going to be parties to any such arrangement, we had no power to influence it. Russia made the arrangement herself, and would probably have done so if we had left the Convention altogether. Our ports would have been open in either case, and there was nothing in our action which influenced Russia to come to this arrangement. Germany would have forced Russia whether we were parties to the Convention or not. Germany probably used the lever of the old competition of the bounty system, which was a very powerful one, to press Russia to accede lest the latter's sugar be exposed to the competition of German bounty-fed sugar. In effect, said Sir E. Grey, "let me assume that we had denounced the Convention and were outside it altogether. What I conceive would have happened would be this. Germany would have said to Russia:—'Unless you will come into this Convention we, Germany, will re-establish our bounty system, and there will be no Convention. But you, Russia, will suffer, because the German bounties we shall re-establish will be so powerful that Russian sugar will not be able to compete in the open market with German sugar.' The result of the pressure would have been—as it has been—that the Convention would have been continued. My point is that the Convention would have gone on, not because Germany established bounties, but because other countries were afraid she would."

As regards the effect on price, he pointed out that as the Russian export to this country had only averaged 40,000 tons for many years, a limit of 200,000 tons a year could not be said to press heavily on the market.

His final remarks summed up the case admirably for the Government:—

"Well now, on the Convention our delegate will, as in the case of Italy, advocate that there should be on the part of other Powers the greatest freedom of export and import; but if he does not carry his way on the Convention it does not matter to us. Our ports remain open, and if Italy cannot get all that she desires, she is just as free to send sugar to us, if she pleases, because her ports are not restricted, neither are ours. The real objection to the Convention, as I have said, is the penal clause. It was this, that we were one country—one consumer, with a number of producers in the majority who might form a ring and outvote us, and might oblige us to close our ports, first to one country and then to another. Under the old Convention we might one year be able to import sugar from Brazil. The next year it might be decided that Brazil gave a bounty, and it might be demanded that we should close our ports to Brazilian sugar. That, in my opinion, was always the great drawback to the Convention. The decision as to what were bounties and what were not rested with the producing countries who were in the majority. It was to their interest to put the widest construction on bounties and to our interest to put the narrowest, and gradually the net might be drawn closer and closer round us, and we might be bound to close our ports more and more to the sugar of other countries, being overruled by the majority on the Convention. Under the modified Convention that danger is entirely gone. We cannot now be asked to close our ports at any time. We know exactly where we are as long as the agreement between Russia and other countries holds good. With regard to the whole world, whatever the Convention may do, it has put us in a position of freedom, and it cannot impose on us the obligation to close our ports to sugar from whatever quarter it comes. I maintain that the Government have secured the freedom and liberty of this Country. We could not have prevented, in my opinion, the arrangement Russia has come to with other countries if we wished. We could not have prevented the Convention being continued without us and on terms far more unfavourable to us. So far from thinking that we have sacrificed the interests of this country, I think the Government have surveyed and considered the whole situation, not only the economic, but the political situation involved, and they deserve some credit for having secured the liberty we have with regard to the import of sugar, and for having secured it without an economic rupture with other countries."

The figures of consumption of sugar during the first eight months of the 1907-1908 campaign in Europe show the following increases over those of the previous year: United Kingdom, 15,000 tons; Germany, 42,680 tons; Austria-Hungary, 8,060 tons; France, 4,673 tons; Holland, 638 tons; and Belgium, 519 tons.

SUGAR REFINERS AND THE REDUCTION OF THE SUGAR DUTY.

It is probably too soon, after only four weeks' experience, to arrive at a correct estimate of the effects on the sugar refining industry of the reduction of a farthing per pound on the duty on refined sugar.

For some weeks before the Budget the belief seemed to have taken complete hold of the retail grocers of the country that Mr. Asquith, in accordance with a hint let fall by him last year, would abolish or, at least, considerably reduce the tax on sugar. The consequence was that the duty-paid stocks held by them were depleted to the uttermost, and only kept up, from hand to mouth and from day to day, by small quantities drawn from the stocks lying under bond in the refinery warehouses. Business was accordingly greatly restricted and the bonded stores of the refineries filled to overflowing. When these were full the refineries had to be put on short time, or closed for a brief period altogether. The 18th of May, the day fixed for the reduction taking effect, was looked forward to by the dealers and refiners as a date marking the commencement of abnormally large deliveries; such proved to be the case, and for the following week or two the powers and appliances of the refiners were taxed to the utmost to fulfil the orders for sending out goods, so that the retail traders might replenish their stocks and get into their ordinary position for supplying their customers. By the middle of June the vacuum seems to have been filled up, and the deliveries from refiners' stores have reverted to the ordinary quantities.

The public have got the full benefit of the reduction of the duty. This is somewhat of a disappointment to the refiners, who, previous to the Budget, had been selling their refined sugars at comparatively low prices compared with what they were paying for their raw material, the expected reduction in duty being to some extent discounted. It was expected that, in order to restore a fair working margin, the refiners would be able to secure some small portion of the abatement, if any were made; and on the first day it appeared as if this would come about, as the prices paid and bid for refined sugar on the 18th of May did not show the full farthing reduction from the quotations of the previous week. It happened, however, that the raw sugar markets began to show a decided downward tendency immediately after the change of duty, and as usually occurs in a falling market, when the decline becomes more rapidly apparent in the value of the manufactured article than in that of the raw material, the refiners were unable to secure to themselves any of the reduction, and the duty-paid price, in a very few days, was reduced to the public to the full extent of the remission afforded by the Budget proposals.

It may be expected that in consequence of the cheapening of the retail price there may come a slightly increased consumption of sugar; if that expectation is realised the refining industry should, of course, benefit by the expansion of trade, but that appears to be the only direction in which it can look for any benefit from the reduction of the duty.

The refiners did not, as a trade, take any prominent part in pressing for a reduction of the duty. One point, however, in connection with the expenses incurred by the refiners through the necessity of carrying on their business under the supervision and regulations of the Customs authorities, was strongly urged upon the Government by all sections of the British sugar refiners, namely, the fact that they are not treated in the same way as manufacturers of other dutiable articles, such as spirits and tobacco. In these other cases a certain abatement of duty is given to home manufactured goods compared with what is charged on similar goods imported from abroad, presumably to equalize the competition between the foreigner and the British manufacturer by allowing the latter a slight compensation for the extra trouble and expense put upon him through compliance with the requirements of the Government. It was suggested, on the basis of the then existing duty, that a reduction of 2d. per cwt. should be made on the duty on sugars refined in this country under bond. The Government did not see their way to concede this, and no reference was made to it in Mr. Asquith's Budget statement. The refiners therefore, being still obliged to work under bond, have not obtained any direct benefit from the provisions of the Budget.

Whether it is of any service to the British sugar refiner that a small amount of duty on sugar has been retained, depends on the view one takes of the probability of the continuation of the International Convention for the suppression of bounties. The Brussels agreement has been extended for other five years, with the very important modification that Britain is not to be bound to penalize bounty-fed sugar. But the Convention, as concerns the suppression of bounties, remains in force in regard to the other contracting countries, so that, during the next five years, the refiners of this country will compete on equal terms in the British market with sugars produced in Germany, Austria, France, and the other countries parties to the Convention. And although the bounty-fed sugars of Russia may not at present be penalized there is nothing in the new arrangement to entitle Russia, or any other country granting bounties, to claim admission for their sugars into Britain as a right. It will depend upon the view held from time to time by the British Government whether it will avail itself of the new faculty of admitting bounty-fed sugar without penalty or revert to the original provisions of the Brussels Convention, and apply the countervailing duty or the prohibition therein provided for. There are two possible cases in

which the latter course might be adopted: firstly, the Liberal Cabinet may become convinced that the prohibition or penalizing of foreign bounties, on their being discovered attempting to enter this country, is really, as Mr. Gladstone held, a measure conceived in the interest of Free Trade, and therefore in complete harmony with Liberal principles; or, secondly, the present Government may be replaced by a Unionist administration, who might naturally be expected to revert to the anti-bounty system, for which, as embodied in the Brussels Convention, they were so largely responsible. In either of these cases it may be as well that some sugar duty should remain in force in this country, as it ensures that the Customs machinery is available, whereby the imposition of a countervailing duty, if such were decided on, could be easily brought about. But for the foregoing consideration it would probably have been much better for the British sugar refiners that the duty should have been abolished altogether, when they would have been freed from the endless multiplication of their clerking work, the cost of providing office and other accommodation for the Customs staff at their premises, the constant surveillance of the officers in their works and the considerable charges for officers' overtime, which they have to bear under the existing regulations, as well as from the trouble of finding security for their bonds and the loss of interest on the amount of duty they have to keep constantly deposited in advance with the Customs.

For one item in connection with the change in the rate of duty the sugar refiners have to thank the Chancellor of the Exchequer, namely, his refusal to prolong the period of waiting for the change beyond the 18th of May, which was suggested by the speculators who held duty-paid stocks at the date of the Budget statement. The duties on these stocks had, no doubt, been paid in the expectation that there would be no change, and that they would secure a good market immediately on the conclusion of the period of inactivity which preceded the Budget. It would have been a calamity to the trade in sugar at large had that period of inactivity been in the slightest degree prolonged; but Mr. Lloyd George perfectly understood the situation, and the thanks of the refiners, as well as of all merchants and users of sugar who were not of the number of the speculators for no change, are due to him for his very proper decision.

The sugar cane prospects for 1908 in Peru are reported to be unsatisfactory and the outturn of nearly all factories will be much below the averages of past seasons, this being attributable to plants having suffered much during two years of drought followed by a very cold winter in 1907, under which conditions growth has been checked and fields are very backward. The past summer—January to April—has been more favourable as regards temperature and water, so that in 1909 heavier crops may be harvested.

ON THE DETERMINATION OF REDUCING SUGARS.

By F. Zerban and W. P. Naquin,

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Munson and Walker,* in their method for the determination of reducing sugars, recommend the use of a porcelain Gooch crucible and the weighing of the precipitate as cuprous oxide after drying for one half-hour. A determination made in this way requires from 35-40 minutes, and cannot, in regard to speed, compete with the volumetric method. It would therefore be desirable to shorten the time consumed by the manipulations without changing the method itself. We have carried out some experiments from this point of view, at the same time investigating some questions in regard to the determination of reducing sugars in low grade sugar house products.

Pellet† was the first to suggest the use of Neubauer crucibles instead of the ordinary Gooch for the determination of reducing sugars. This method would save the trouble of purifying asbestos and of preparing the filter, not a small item when a number of analyses are required. The Neubauer crucible offers the further advantage, that it can be heated to red heat, while porcelain Gooch crucibles, when treated in this manner, often lose weight by the breaking off of small particles from the perforated bottom.

Several series of analyses were made using the method of Munson and Walker, but substituting Neubauer crucibles for the ordinary Gooch. The crucibles used were secured from the Vereinigte Fabriken für Laboratoriumsbedarf, Berlin, and weighed 22 grm. each. It was found that they serve the purpose very well, completely retaining the cuprous oxide, and allowing of very rapid filtration.

The experiments were made with an invert sugar solution prepared according to the directions given in Spencer's Handbook for Cane Sugar Manufacturers. The cuprous oxide precipitate was first weighed as such, after drying for 30 minutes in a water oven, and it was then converted into cupric oxide by heating in air or oxygen. In order to prevent the access of reducing flame gases to the material, the crucible was placed in a small platinum dish. The manufacturers also furnish crucibles with a platinum cap. In the first series of experiments the cuprous oxide was heated for 10 minutes over a Bunsen burner and the following results were obtained:—

* Jour. Amer. Chem. Soc. 28, 663.
† Bull. Assoc. Chim. Sucr. Dist. 24, 1392.

Cu_2O.		CuO.		Cu from Cu_2O.		Cu from CuO.
·2700	....	·2955	....	·2396	....	·2361
·2700	....	·2985	....	·2396	....	·2385
·2730	....	·2970	....	·2424	....	·2363
·2760	....	·3020	....	·2450	....	·2413
·2720	....	·2990	....	·2414	....	·2389
·2710	....	·2990	....	·2406	....	·2389
·2730	....	·3010	....	·2424	....	·2404
·2695	....	·2990	....	·2392	....	·2389
·2730	....	·3010	....	·2424	....	·2404
		Average..	..	·2410		·2387
		Difference			0·0023	

As seen from the table, the weight of copper calculated from the cupric oxide is in every case lower than that calculated from the cuprous oxide. That this is not due to incomplete oxidation of the cuprous oxide was proven by a second series of experiments where the cuprous oxide was heated for 30 minutes in a current of oxygen, with the following results:—

Cu_2O.		CuO.		Cu from Cu_2O.		Cu from CuO.
·2648	....	·2924	....	·2351	....	·2336
·2632	....	·2902	....	·2337	....	·2318
·2666	....	·2936	....	·2367	....	·2345
·2666	....	·2936	....	·2367	....	·2345
·2664	....	·2934	....	·2365	....	·2344
·2675	....	·2957	....	·2375	....	·2362
·2688	....	·2948	....	·2386	....	·2354
·2650	....	·2920	....	·2353	....	·2333
·2638	....	·2920	....	·2342	....	·2333
·2658	....	·2950	....	·2360	....	·2357
		Average..	..	·2360		·2342
		Difference....			0·0018	

It is apparent that the heating in air for 10 minutes over a Bunsen burner is sufficient for a complete oxidation. The discrepancy of the results must therefore be due to some other cause. In order to arrive at a conclusion about this point, we had to determine the metallic copper in the precipitate. Several methods could be used for this purpose, reduction by hydrogen, electrolysis, or some volumetric method. The first method could not be used on account of the danger of the reduced copper forming an alloy with the platinum. Since we are not equipped for electrolytic determinations, Low's volumetric method was adopted for the purpose, with very satisfactory results.

Two series of 10 and 3 experiments respectively, gave the following figures:—

Cu from Cu_2O.		Cu from CuO.		Cu by Low.
·2378	....	·2359	....	·2354
·2285	....	·2266	....	·2265

The difference between the figures for copper as calculated from the cuprous oxide and from the copper oxide is 0·0019 grm. The copper as determined by Low's method is nearly identical with the quantity calculated from the cupric oxide, but 0·0020-0·0024 grm. lower than that calculated from the cuprous oxide. This shows that, in the method of procedure used, the weight of the cuprous oxide is a little too high. This is necessarily due to small amounts of a volatile substance which is not driven off at the temperature of the water oven. The excess weight is, however, so small that we did not attempt to determine the nature of this substance. In all probability it is nothing but water.

By using Neubauer crucibles and weighing the copper as black oxide, the method of Munson and Walker could be carried out in less than one-half of the time required for the original method. But the difference between the copper calculated from the cuprous and the cupric oxide, prevents the direct use of Munson and Walker's tables. It was necessary to find out whether this difference changes with the quantity of the precipitate or whether it is constant. Some experiments were made with varying amounts of invert sugar with the following results :—

Cu from Cu_2O.		Cu from CuO.		Difference.
·0799	....	·0783	....	·0016
·0792	....	·0772	....	·0020
·2285	....	·2266	....	·0019
·2378	....	·2359	....	·0019
·3641	....	·3626	....	·0015
·4222	....	·4205	....	·0017
·4229	....	·4212	....	·0017
		Average Difference ..		·0017

The difference is found to be constant, and the correction to be applied is 0·0017 grm., added to the weight of the copper calculated from the cupric oxide.

Our experiments were next extended to the analysis of a low grade Louisiana molasses.

In the report on sugar presented at the Jamestown meeting of the Association of Official Agricultural Chemists, it was recommended by the referee to discontinue the use of lead subacetate solution previous to the determination of reducing sugars. It was definitely shown that this re-agent, employed in any form, precipitates considerable quantities of reducing sugars, and especially of levulose. The lower figures obtained for reducing sugars after clarification with lead subacetate are therefore partly due to the removal of reducing sugars. But if the solution be not clarified at all, there is a danger of contaminating the precipitate with appreciable quantities of organic and mineral matter. For this reason the use of such agents which do

not act like lead subacetate was recommended, and normal lead acetate was named as one that may be used for this purpose.

This question of clarification was also studied in connection with the other experiments. In one series the solution was clarified by carefully adding neutral lead acetate solution until no more precipitate was produced; in the second series we did not clarify at all, but simply filtered the solution. In every case the copper precipitated was determined as cuprous oxide, as cupric oxide and by Low's method.

In the following table all the results arranged in the same horizontal row were obtained with the same solution, and give the average of several experiments:—

Clar.	Cu from Cu_2O. Unclar.	Diff.	Clar.	Cu from CuO. Unclar.	Diff.	Clar.	Cu by Low Unclar.	Diff.
·2724	·2789	·0065	·2706	·2758	·0052	·2666	·2720	·0060
·2750	·2800	·0050	·2712	·2745	·0033	·2660	·2680	·0020
·2845	·2857	·0012	·2812	·2817	·0007	·2718	·2735	·0017
·4151	·4220	·0069	·4084	·4139	·0054	·4034	·4078	·0024
	Aver. diff.	·0049			·0037			·0030

If we compare the figures for the clarified and unclarified solutions, we find that they are invariably higher in the latter case. The difference is largest where the precipitate was weighed as cuprous oxide, and smallest where it was weighed as metallic copper.

If we now compare the difference in the weight of copper by the three methods, we find the following:—

Clarified.					Unclarified.				
Difference between		Difference between			Difference between		Difference between		
Cu from Cu^2O.	Diff.	Cu from CuO.	Diff.	Cu by Low.	Cu from Cu^2O.	Diff.	Cu from CuO.	Diff.	Cu by Low.
	·0018		·0046			·0031		·0038	
	·0038		·0052			·0055		·0065	
	·0033		·0094			·0038		·0084	
	·0067		·0030			·0081		·0061	
Aver.	·0039		·0055		Aver.	·0051		·0062	

The difference between the Cu from Cu_2O and Cu from CuO is partly due to the same cause as in the analysis of pure invert sugar solutions, The remainder must be ascribed to the precipitation of organic matter. More organic matter is precipitated from the unclarified than from the clarified solutions, as had been anticipated. The difference between the Cu from CuO and the Cu by Low's method is due to the precipitation of mineral matter. This is in some cases higher in the clarified than in the unclarified solution; in other cases lower.

The results very clearly show the necessity of determining the copper in the precipitate, when analysing low grade products. If this

be done, then only the copper reducing substances are determined. But even then there remains a difference between the clarified and the unclarified solution, the former giving lower results. We know that neutral lead acetate does not remove reducing sugars. The difference must therefore be due to the precipitation of other reducing substances by the neutral lead acetate. Whether any of these remain in solution, thus increasing the apparent percentage of reducing sugars, cannot be decided with our present knowledge of the non-sugars occurring in molasses. However, since the average difference in the reduced copper between the clarified and unclarified solutions was only small, these reducing non-sugars cannot be present in appreciable quantities in the low grade molasses investigated.

Summary.—The time consumed by a determination of reducing sugars with the method of Munson and Walker may be shortened appreciably by filtering the precipitate through a Neubauer instead of a porcelain Gooch crucible and weighing the precipitate as cupric oxide after heating for ten minutes over a Bunsen burner. The tables of Munson and Walker can then be used after adding 0·0017 grm. to the metallic copper calculated from the oxide.

In the determination of reducing sugars in low grade sugar products the quantity of metallic copper present in the precipitate should always be determined. If that be done, clarification with just a sufficient amount of neutral lead acetate may not be necessary in all cases, but it is advisable to use it, because it will remove at least a part of the reducing non-sugars without affecting the sugars.

The use of a Neubauer crucible has, in all these cases, no advantage over the asbestos tube or Gooch crucible, because the precipitate must be dissolved again.

It appears that in the analysis of low grade products the volumetric method is preferable to the gravimetric, because the errors produced by the precipitation of organic and mineral matters are avoided, and fairly accurate results may be obtained in much less time. Among the different volumetric methods we have recently made some experiments with that proposed by Ivar Bang.* It does not seem to answer the purpose as well as the usual method. The solution employed contains too little copper sulphate per litre, and it is impossible to dissolve more without changing the quantities of the other ingredients. If it be done, the precipitate obtained is not pure white. Moreover, the end-point is not sharp enough when highly coloured products are analysed.

The Cuban production up to May 31st was 900,255 tons, and it is not expected that this will be increased by more than 25,000 or 30,000 tons. The weather has been very favourable to the growing canes, rains having been general and abundant.

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* Biochem. Ztschr., 2, 271.

THE DETERIORATION OF SUGARS ON STORAGE.

As sugars produced in the Hawaiian Islands are often stored over lengthy periods, taking as much as 130 days in transit round Cape Horn to New York, the question of their deterioration on storage has proved a matter of sufficient moment to receive the close attention of the Hawaiian Sugar Experiment Station authorities, and the results of investigations, conducted chiefly by Messrs. Noël Deerr and R. S. Norris, have just been embodied in Bulletin No. 24 of the Experiment Station.

A number of sugars were obtained from 30 factories and were analysed at intervals to ascertain their keeping qualities. Practically all these sugars were made from juices limed to neutrality or to slight alkalinity. Thirteen of them were washed with water in the centrifugals, and seven of them had been passed through a Hersey Drier. The determinations made on the sugars were: polarization; sucrose (Clerget) %; glucose %; moisture %; ash %; chlorine %; number of organisms per gram; acidity.

The tabulated results of analyses show clearly that a connection exists between moisture and the keeping qualities of sugars. "The average percentage of moisture in the sugars which deteriorated is 1·49, and in those which retained their polarization is 1·02; this result points to the advisability of reducing the moisture to as low a figure as is possible; at the same time, a low content of moisture in a sugar does not always mean that the sugar will retain its polarization on keeping, as amongst the sugars that have deteriorated are two which have less than 1% of moisture, but notwithstanding it is evident that a connection between deterioration and high moisture does exist. The value of a low content of moisture, in this instance obtained by drying the sugars in a Hersey Drier, is illustrated in a very vivid manner in the sugars 36 A and 36 B. These sugars had a very low percentage of water, ·69% and ·51% respectively, and contained at the same time a relatively enormous number of organisms which, owing to the dryness of the sugars, were unable to develop and thus cause a fall in polarization. These sugars came from a factory which had at one time great trouble with deterioration, which after the installation of a drier disappeared. When these sugars were allowed to become wet by standing in a moist atmosphere, a very rapid fall in polarization was observed."

None of the sugars were alkaline, but all as determined by means of phenolphthalein showed an acid reaction. Experiments showed, however, that no connection existed between the acidity of the sugars and their keeping qualities.

In the bacteriological examination of the sugars a plan was formulated for ascertaining the number of organisms, and was carried

out as follows:—"A quantity of sugar (we found that ·25 gram was a convenient amount) was weighed out on to a square of sterile paper, and transferred to a tube of sterile nutrient agar, the temperature of which was from 45° to 50° C; the sugar was allowed to dissolve, and after solution the contents of the tube poured into a sterile Petri dish, the usual precautions to prevent accidental contamination being scrupulously followed. At first organisms in these plates were allowed to develop at room temperature, and later, as the weather became colder, in an incubator at 30° C. After 48 hours the number of organisms which developed into colonies was counted. The nutrient medium we used in these determinations was that recommended by Grieg Smith, and was of composition—agar agar 1·5%, sugar 10%, potassium chloride ·5%, sodium phosphate ·2%, peptone ·1%."

"The colonies in each plate culture made were subjected to a microscopical examination, and a preliminary classification of the organisms made. Five organisms capable of differentiation by microscopical examination were of frequent occurrence:—

1. Rods with terminal spores associated with a surface amoeboid growth on the agar plates.

2. A pear shaped organism exceedingly granular, associated with raised, smooth and slimy colonies.

3. A short thick spore forming rod generally occurring in pairs, and less frequently in chains up to seven, the refractive spore causing the pair of organisms to simulate the appearance of an organism with two spores.

4. A very small rod shaped organism only distinctly visible with very careful focusing, associated with a smooth raised growth on the agar plates.

5. Yeasts.

"For the present we may say with reserve that we have not positively identified any of the organisms found with the *Bacillus levaniformans* of Grieg Smith."

The results of these determinations are summed up by the two experimentists as follows:—

1. Generally, deterioration of sugars can be connected with bacterial activity.

2. Cases however occur where sugars deteriorate excessively and in which the deterioration can *not* be attributed to bacterial activity.

3. Sugars retaining a large number of organisms retain their polarization provided they contain but little water.

The effect of sterilization on sugars was shown by a further experiment. A quantity of sugar was poured into several wide-mouthed flasks and to them was added drop by drop a solution of a sugar known to be infected with micro-organisms. Three of the flasks were then submitted to fractional sterilization at 100° C for a period of 20 minutes on three successive days. A fourth flask received no sterilization. These flasks, all plugged with cotton wool,

were then placed over a flat dish containing water and covered with a bell jar; a fifth flask containing unsterilized infected sugar was placed in a similar position, the water being replaced by a 40% solution of formaldehyde.

The amount of water absorbed by the different lots averaged about 5 per cent. They were polarized at the commencement and again after 45 days. A very large fall in the polarization of the infected and not sterilized sugar was noted, and a smaller one in the sugars that had been sterilized, the sugar in the presence of the formaldehyde remaining stationary.

Experiments were next undertaken to determine the percentage of water at which deterioration begins. They revealed a distinct fall in polarization when the water present reached 1·04%. As a consequence Messrs. Deerr and Norris feel justified in suggesting 1% of water as the maximum allowable limit in raw sugars if they are to be stored for any length of time. There must, of course, be exceptions to this rule, but it is safe to say that a sugar containing less than 1% of moisture will in all probability retain its polarization.

The effects of using the Hersey drier come in for some mention. In this drier the sugar is raised to a high temperature, which varies from 130° to 160° F., and in local practice the sugar remains in the apparatus from 5 to 15 minutes; it was, therefore, considered advisable to investigate its effect on the bacterial content of the sugars. Accordingly three sugars were exposed to a temperature of 176° F. for 10 minutes and then inoculated. The conclusion drawn was that the action of the Hersey drier has no effect whatever on decreasing the number of organisms present, and its sole useful effect is considered to be the reduction of moisture in the sugars to such an extent that the micro-organisms cannot develop.

As already mentioned, some of the sugars under examination were washed with water in the centrifugals. It was found that this washing tends to produce a loss in polarization, in that owing to the dilution of the molasses attached to the crystals a most favourable medium is afforded to the growth of micro-organisms than is the case if the film of molasses is more dense.

That the size of grain influences the absorption of moisture was demonstrated by experiments which showed that a small grain will absorb moisture more quickly and retain a larger amount.

Tests were also made to show whether there was a relation between the amount of chlorine present in the ash and the amount of water absorbed. It was shown that the average amount of water absorbed by sugars of low chlorine content was 0·90% and by those of high chlorine content 1·56%. This great difference was not to be attributed entirely to the presence of chlorides, but the evidence points to the fact that a high content of chloride in the juice, and consequently in

the sugars, is a cause of "sweating" of sugars. Such excess of chlorides may perhaps be connected with irrigation with saline water, with the presence of chlorides in fertilizers, or in the soil itself.

During these experiments some attention was also given to the question of the "sweating" of sugars. Certain sugars that had "sweated" in the hold of vessels in which they had been shipped were analysed. They had fallen in polarization about five points; but it did not appear that the number of organisms in them was much in excess of that of sound sugars. In all cases the "sweated" sugars are much more hygroscopic than sound sugars of the same shipment, but with the data available it is impossible to say if this high absorption of water is due to bodies already present or to products of decomposition due to bacterial action. In one experiment it was evident that the sugars had "sweated" on account of the presence of certain impurities, and that then, owing to favouring conditions, bacteria had been responsible for the fall in polarization.

This leads to the question of using proofed bags or bags lined with specially prepared paper as a means of lessening or even preventing this "sweating." Special bags made of this material were filled with raw sugar and exposed in company with similarly filled bags made of ordinary material. Both classes were susceptible to moisture, but the paper bags proved the better receptacles. And though it cannot be said that they prevent all absorption of moisture, they undoubtedly tend to mitigate sweat damage. Whether their use is practicable depends on the cost of the bags and the amount of sugar they will save from damage. The extra cost was put by one firm at 50c. to 60c. per ton of sugar.

The joint authors conclude their paper with some suggestions, which may be quoted in full. "Provided that a sterile sugar could be made, that it could be kept sterile, there is no doubt that a very great part of the loss due to deterioration could be prevented. It is a matter of no inconsiderable difficulty to sterilize even small articles in the laboratory, and the sterilization of so large a matter as a sugar factory may be regarded as impossible. In one of his communications Grieg Smith shows that in Australia the organism *Bacillus levaniformans*, which he associates with deterioration, exists in the juices and syrups at all stages of manufacture, and hence its presence in the sugars is unavoidable. Similarly, the presence of micro-organisms has been noted by Laxa in all stages of manufacture in beet sugar factories. Notwithstanding this, we think that all efforts toward a clean factory and to a rapid process of manufacture will be well rewarded. The place in the sugar factory most suited to the development of micro-organisms is the tanks used for storage of after masse-cuites, and to the remelting of these sugars is to be attributed the introduction of many micro-organisms. This is not, however, the sole cause, as amongst the sugars we examined were some which came from a factory using

a crystallization in motion process, and these contained a very large number of micro-organisms.

"Provided sugars are dry, no danger from bacterial damage is to be apprehended; dryness in sugars can be obtained by artificial drying by heat, but if such dried sugars are stored for any length of time they will, under unfavourable conditions, absorb moisture. To a limited extent we think that the use of an interior "proofed" bag is worthy of trial where sugars have to be stored under unfavourable conditions. With regard to treatment of sugars we have shown how that the action of small quantities of alkalies on dextrose gives rise to hygroscopic decomposition products, and consequently any excess of lime, particularly with juices containing much glucose, will tend to give a hygroscopic sugar, and hence one liable to deterioration.

"A thick, viscous material, such as molasses, is not a medium well suited to the development of micro-organisms, but if the film of molasses be diluted, as will occur if the sugars are washed, a more suitable habitat for their development is formed. The sugars we have examined afford evidence that washed sugars are liable to deterioration, and we would add that the use of any but distilled water in washing sugars is a process likely to introduce large numbers of micro-organisms."

RED ROT DISEASE OF THE SUGAR CANE.

In 1903 we published in this Journal a paper, "On the 'Rind' Disease of the Sugar Cane in the West Indies," by Albert Howard, in which the writer gave some details of his experiences with diseased canes which had come under his notice when he was attached to the Staff of the Imperial Department of Agriculture in the West Indies.

His conclusions may be set forth again for comparison with the subsequent investigations to be chronicled below. They were :—

1. The "rind" disease of the sugar cane in the West Indies is identical with the "Red Smut" disease of Java, and is caused by the fungus *Colletotrichum falcatum*, Went. It can infect ripening canes at wounds and at old leaf-bases, and can overcome the tissues of young canes which are capable of growth and development.

2. The *Melanconium* found on diseased sugar canes in the West Indies is a saprophyte, and is not the cause of the "rind" disease. It infects canes easily at points when they have been invaded by *Colletotrichum*.

3. The directions in which experiments should be conducted, on an estate scale, to test the value of remedial and preventive measures against this disease, appear to be as follows :—

(*a.*) The destruction by burning of the diseased canes at reaping time.

(*b.*) The early reaping of fields in which the "rind" disease makes its appearance to any considerable extent.

(*c.*) Removal of the dead leaves of the cane during the period of growth.

(*d.*) The use of the best cuttings as plant material.

(*e.*) The control of boring insects.

Since Howard issued the result of his investigations, other experimentalists have reported the disease, Tryon in Queensland, Barber in Madras, and more recently Butler in Bengal. The latest contribution to the subject comes, however, from Hawaii, where Mr. L. Lewton-Brain—Mr. A. Howard's immediate successor in the West Indies, who subsequently went to Hawaii—has made a careful and detailed study from somewhat scanty material at his disposal of what he designates the "Red Rot of the Sugar Cane Stem." The result of his investigations forms the substance of a 44-page Bulletin* and as it is a subject of no little interest to cane planters we propose to give here a resumé of this paper with some fairly full extracts.

We said the investigations were made from somewhat scanty material, inasmuch as Mr. Lewton-Brain states at the outset that all the evidence indicated that there is very little of the disease on the plantations in the Hawaiian Islands. But his work does not appear to have been any the less thorough for the scarcity of well authenticated instances.

First a word as to the nomenclature. Mr. Lewton-Brain has been at somewhat of a loss to select a common name for describing the disease. He thinks Deerr's "Red Smut" hardly admissible and rather than invent a new name follows Butler in calling it "Red Rot." In any case, however, it is established to be the disease produced by the fungus *Colletotrichum falcatum*, first discoverd by Went in Java about 1893.

The first case met with in the Hawaiian Islands, which it was hoped would throw some light on the question of the incidence of the disease, occurred in 1907 when it was reported that certain fields of a plantation were giving canes of a curiously low purity, and the cane was said to be attacked by borer. Subsequent examination of these canes, however, revealed dark red discolorations in the central sugar-containing tissue, and under the microscope these were found to contain a septate mycelium with thin walls and noticeable oil globules very like that of *C. falcatum*. This mycelium was, in later specimens, connected with the characteristic chlamydospores of *Colletotrichum*, thus proving the identity of the fungus.

The case cited proved the only certain record of red rot in Hawaii. It, however, suggests that there might have been other cases which were not reported, for in the instance given the canes had evidently been

* Bulletin No. 8 (Division of Pathology and Physiology) of the Experiment Station, Hawaiian Sugar Planters' Association.

attacked first by Borer (*Spen. obscurus*) and in all probability the damage would have been ascribed to the Borer, had not one of the Experiment Station staff, Dr. Norris, fortunately seen the canes when they were being ground.

Wishing to ascertain the prevalency of the disease amongst the plantations, Mr. Lewton-Brain issued a short circular, briefly describing and illustrating the disease, and requesting that suspicious specimens might be reported. The response was very limited, and while proving that there has as yet been no severe outbreak of red rot in those Islands, it was clear from other independent evidence that many of the plantation managers were not sufficiently familiar with the disease to recognise it and might think the canes had died a natural death where red rot had been the real trouble.

The next step was obviously to place before them all the available information which would assist them in diagnosing the disease. Accordingly the major part of the Bulletin is taken up with descriptive notes, comprising translations from Went and Wakker, a quotation from Butler regarding a very bad outbreak of the disease in Behar, and details of the experiments personally undertaken by Mr. Lewton-Brain and his colleagues.

The fungus (*Colletotrichum falcatum*) is one that comparatively seldom produces its fructifications. Wakker and Went state that these can be found in nature in cracks and upon bud scales of dead buds on cane attacked by the fungus, but Mr. Lewton-Brain could only find them on dead or dying leaves or leaf sheaths. He also failed to verify the same authors' statement that by taking a piece of diseased cane and letting it dry out slowly, fructification would be formed in a few days. Yet, "if one could compass the exact conditions under which to keep the diseased cane, the formation of the fructification would be of great aid in identifying the disease."

The following is a translation of Went's original Latin description of the fungus:—

Colletotrichum falcatum, Went.

Setae sometimes in rows, sometimes united into a pseudo-conceptacle, sharply pointed, 100 to 200 by 4 micromillimeters, dark coloured, lighter above. Conidia falcate 25 by 4 μ, hyaline, at base of setae. Basidia ovid 20 by 8 μ, hyaline or dark. Habitat. In living stems.

The naturally occurring fructifications are just visible to the naked eye as dark points from which stand out a number of dark stiff bristles, the *setae*. These are sometimes just large enough to be picked out individually with the naked eye and can be easily distinguished with a good hand lens. They are of a dark brown or sooty colour at the lower part, but almost colourless above. Each is composed of a row of cells. They arise from a small cushion composed of hyphae very closely woven together, the *stroma*, which varies in colour from colourless to dark black. Besides the setae, there arises from the

stroma shorter colourless hyphae, the *basidia*, which are one-celled; at their tips are produced the spores or *conidia*. These conidia are very characteristic, and unlike those of any other cane fungus. They are very constant in form and appearance and fairly so in size; one-celled and colourless, and always slightly curved, or sickle-shaped, hence the name "falcate" from which has arisen the specific name of the fungus.

Besides the true conidia, the fungus also produces the so-called *chlamydospores* which are formed on the ordinary vegetative hyphae; a cell swells up, gathers a quantity of refractive oil drops, which often run together into one or two large drops, and finally the walls of the cell thicken and become dark brown in colour. The chlamydospores, according to Went and Wakker, arise sometimes from the tip but more often in the middle of a hypha. Mr. Lewton-Brain's experience points to a far more frequent origin at the end of a hypha. Butler's specimens were also mostly terminal ones.

The chlamydospores are probably of the nature of resistant bodies; their thick walls are more impervious to dessication than the thin-walled ordinary hyphae; and it appears to be a fact that they are produced in greater numbers and earlier when the fungus is grown under unfavourable conditions. There is however little evidence available for ascertaining their precise function.

To turn now to the presence of the fungus in the cane, the following description of a microscopical examination of a diseased stem is taken from Went and Wakker by Mr. Lewton-Brain and may well be given here.

"If one examines the diseased tissue under the microscope, it will be seen to contain the mycelium of a fungus, which is especially found in the parenchyma. This mycelium appears to be characterized by the possession of a number of small oil drops soluble in alcohol and ether.

"The cane tissue appears to be dead, in consequence of which in the red spots the cell-walls are impregnated with a red-brown colouring matter, which is lacking in the white spots. The contents of some of the dead cells have changed to a red-brown, granular mass. A formation of gum may appear in the vascular bundles, as well as in some parts of the parenchyma.

"The white spots are seen to be groups of cells, the contents of which have become replaced by air. If a white spot which has just appeared be examined, the fungus is always found; in older spots it is seen at the edges, but not always in the centre. The fact seems to be that the hyphae slowly disappear, becoming dissolved in some manner, while the oil drops may still remain; one often finds these drops in rows, indicating the course of the former hyphae. In the red spots few hyphae are to be found. The fungus appears to secrete a poisonous substance which kills the surrounding

tissue. As a result of this the cell-walls assume the red-brown colour; as the fungus penetrates the dead tissue the red colour disappears again; finally, the fungus itself dies away behind, and all that is left are the cell-walls with air in their cavities.

"The fungus is also found in the viscular strands which pass into the buds, when the strands themselves show a red-brown colour. In this case it is found that the hyphae are present mainly in the cells and the fibres of the vascular bundles, seldom in the vessels proper. The walls of the surrounding cells also show a red-brown colour."

This account tallies with what Mr. Lewton-Brain experienced. He, however, adds that "one essential point to be noted is that it is mainly the thin-walled tissue that is attacked; that is, the cells in which the sugar is stored and not the vascular system; this agrees again with the facts noted in artificial cultures that it is on media rich in sugar that the fungus grows best."

"The Red Rot fungus is essentially a wound parasite, there being no record of its ever being found able to penetrate the unbroken rind of the cane. More than this, a mere surface wound in mature joints is not a favourable avenue for infection. In order that the fungus may successfully enter the cane and carry on its destructive work, it is necessary that it be introduced artificially or naturally into a wound that goes through the rind into the softer sweeter tissues of the stalk."

Such wounds are those produced by the Borer (*Sphenophorus obscurus*). Leaf Hopper punctures do not apparently go deep enough for *C. falcatum*. At any rate all the canes infected by red rot which were examined by Mr. Lewton-Brain were clearly entered from borer tunnels; and it is worth noting that the three plantations which last year had the juice of the lowest purity were the three accounted by the Entomological Department as being the most severely affected by Borer. Yet as both Barber and Butler point out, the opportunities offered by borer wounds are by no means sufficient to account for the whole of the infections. The comparatively sparse production of spores by the fungus would render unlikely any wide-spread infection of canes through wounds.

"In considering borer infection the resistant powers of the canes must not be lost sight of. Thus it would be quite possible for canes of resistant varieties to be affected quite badly by borer wounds and to be inoculated with the spores of *Colletotrichum*, and yet not contract the disease, the fungus not being able to make headway against the resistance of the tissues. There are three factors necessary to a successful infection—the presence of a wound, the presence of spores (or mycelium) of *Colletotrichum* in the wound and, thirdly, a susceptible condition of the cane."

Butler and Barber conclude that when the disease is well established it must pass to the epidemic stage by the planting of diseased cuttings, and so far no evidence controverting this view has been forthcoming. In such cases it is possible to obtain some confirmation from the fact that the discoloration starts at the base of the stalk.

In whichever way the attack begins, the after progress of the disease is in essentials the same. The growing mycelium of the fungus probably secretes some substance which is poisonous to the living cells of the cane tissue. The hypæ then enter these cells, destroy their contents, and repeat the process until a considerable area of the cane tissue is killed and the contents of the cells are destroyed, or at any rate completely changed. The fungus does not seem able to affect the harder tissues of the outer part of the stalk, nor does it enter the vascular bundles.

"It is thus easy to understand why the general nutrition and health of the cane do not usually suffer. The sources of the food supply—the roots and leaves—are unaffected; and it is in the leaves also that the manufacture of elaborated foods—sugar, &c., is carried on. This also is not interfered with. Furthermore, as the vascular transporting system is not invaded, the circulation both of raw food material, including water, and of elaborated foods can go on normally."

The damage indeed is confined to the destruction of the thin-walled parenchyma, where the sugar cane stores its reserve sugar. As it is for this sugar that the cane is cultivated, the damage caused may be as great as though the cane were killed, for the sugar is destroyed.

The following figures were obtained of analyses of the one recorded case of red rot in the Hawaiian Islands. Both sound and borer canes from the same field were sampled:—

	Brix.	Sucrose.	Glucose.	Purity.
Sound cane	18·2	16·00	0·33	87·9
Borer cane	16·75	12·10	1·26	72·2

These results as regards decrease of sucrose and increase of glucose tally closely with the results obtained in Java and India.

So far it had been proved that the mycelium found on the tissues of the diseased canes were those of *Colletotrichum falcatum*; but it had yet to be proved that the disease was due to the presence of such fungus, as fungi are very frequently found on diseased or dying tissues which have nothing to do with bringing about the disease in question.

The only satisfactory method was to isolate some healthy canes and inoculate them with the spores of *Colletotrichum*, at the same time having certain control canes. If the latter ones did not show any symptoms of the disease while the inoculated ones did, then the connection between the fungus and the disease might be regarded as proved.

Went was the first to experiment in this direction, and he got conclusive results, absolutely proving the connection between red rot and *Colletotrichum*.

Mr. Lewton-Brain started similar experiments in the summer of 1906. To determine whether the fungus could attack any other part of the plant besides the stem, he stabbed a number of young leaves with a sterilized needle, and introduced into the wounds Colletotrichum spores. Not one of them showed any signs of infection, however; the tissues just round the wound dried up, but the rest of the leaf in every case remained perfectly normal.

Another similar experiment on young shoots had the same negative result. And no better result followed the placing of solutions of spores on a number of young leaves of plants growing under cover. In all these experiments the cane used was Yellow Caledonia (White Tanna), being the only cane variety available at the time.

Next, some canes were inoculated by placing spores from a plate culture into a wound in the rind with a sterile needle. Five canes were stabbed as controls, no inoculating material being introduced into the wounds. Two months later two of the pairs were split open and examined. In the controls there was a slight discoloration along the actual line of the wound. In the inoculated ones there was a red discoloration, starting at the wound and spreading the whole length of the joint; there also appeared indications that the disease was spreading through the nodes to the internodes above and below. The remainder of the experimental canes were cut 12 months after inoculation. It was found, however, that, contrary to anticipations, the fungus had not spread any further than in the canes cut 10 months previously. In short, the fungus had not been able to progress beyond the first internode. And there was no sign of the disease externally.

That the discoloration was really due to *Colletotrichum* was proved by finding the mycelium and chlamydospores of this fungus in the diseased tissues.

The experiment was more interesting for not being more successful, as it showed in the first place that the Yellow Caledonia although not immune to the disease is certainly quite resistant to it. Again it was proved that *Colletotrichum* does not always produce the typical symptoms described by Went; it looks as if the variety of cane attacked might be an important factor in determining the exact symptoms of the disease. More than this, however, cannot be gathered from so small a number of experiments.

But the outstanding feature of the attack of *C. falcatum* on the cane is the inversion of the sucrose. Consequently it is interesting to note the results of some experiments carried out by Messrs. Noel Deerr, S. S. Peck, and R. S. Norris, to test this inverting action. We venture to quote them in full, believing they will prove of value to our readers.

The first experiments were made with living fungus by growing it from pure plate cultures in flasks containing diluted expressed cane juice. The flasks were inoculated December 13th, 1906, and with the controls were analysed on December 26th; the results were as follows:—

	Inoculated. Per cent.	Control. Per cent.
Sucrose	13·23	13·50
Invert sugar	7·25	6·60

There thus appeared a loss of sucrose amounting to 0·27 per cent. while the invert sugar had increased by 0·65 per cent., equivalent to 0·62 per cent. sucrose. The controls had been treated exactly as the inoculated flasks during sterilization, &c., so that the only possible explanation of the anomaly was that the fungus must have destroyed one part of the invert sugar—the levulose, thus giving too high a reading for the sucrose. There was not enough of the solution available for more direct analysis.

The next experiment gave similar, but not quite such striking results. I had thought it better to work with solutions of simpler and more definite composition than cane juices, and had inoculated two flasks of 10 per cent. cane sugar solution to which small quantities of nutrient salts had been added, two others serving as a control. The experiment was started December 26th, before I had the results of the first test, consequently the quantities used were again insufficient for complete analysis. The results on January 9th were, the quantities expressed as grams per 100 c.c.:—

	Inoculated.	Control.
Sucrose	7·37 ..	8·10
Invert sugar	2·51 ..	1·50
Loss of sucrose..	0·73 grams per 100 c.c.	
Gain in invert sugar	1·01 grams per 100 c.c.	

There was thus an apparent gain in total sugar (expressed as invert sugar) of 0·24 grams per 100 c.c., the sucrose lost per 100 c.c. being equivalent to 0·77 grams of invert sugar.

The next flasks were inoculated January 4th, 1907, larger quantities of the same solution being used. The results were, on January 17th:—

	Specific Gravity.	Sucrose.	Glucose.	Dextrose.	Levulose.	Reaction N/10 Acid.
Control.. ..	1·0646 ..	13·71 ..	4·18 ..	2·04 ..	2·14 ..	·23
Inoculated ..	1·0639 ..	13·17 ..	4·69 ..	2·37 ..	2·32 ..	·375

Loss of sucrose..	0·54 grams per 100 c.c.
Gain of glucose	0·51 grams per 100 c.c.

There was thus an apparent total loss of sugar equal to 0·06 grams of glucose per 100 c.c. solution. It is noticeable that while the dextrose in the solution has increased by 0·33 grams, the levulose has only increased by 0·18 grams, thus confirming the assumption that the actual lost of sugar falls upon the levulose.

The last experiment was started January 26th, and the analyses made March 29th, thus affording time for greater changes to take place. The results are given in the following table:—

	Specific Gravity.	Sucrose.	Glucose.	Dextrose.	Levulose.	Reaction N/10 Acid.
Control.. ..	1·0640 ..	14·11 ..	2·10 ..	1·19 ..	0·91 ..	0·22
Inoculated ..	1·0636 ..	3·33 ..	12·95 ..	6·76 ..	6·19 ..	0·22

Loss of sucrose .. .. 10·78 grams per 100 c.c.
Gain of glucose .. .. 10·85 grams per 100 c.c.

Thus the apparent loss of sugar was equivalent to 0·49 grams of glucose, the whole of which appears to have fallen on the levulose. It may be mentioned that the solution as made up contained, per 100 c.c.: sucrose, 18·16 grams, glucose, 0·20 grams; there was thus some inversion in the control solution. Probably this took place chiefly during sterilization through the inverting action of the salts, the chief one probably being the sodium hydrogen phosphate (Na_2HPO_4).

These experiments bring out, even more clearly than the cane analyses, the fact that the main activity of this fungus, as a destructive agent, is its inverting action. Moreover, in the experiments the results are certainly due to the fungus, and are not complicated by the presence of other organisms, or of agents such as enzymes which might be present in the living cane tissues. The action is very marked in the last experiment, where though more than 75 per cent. of the sucrose was inverted, not one-twentieth part of this was actually consumed by the fungus.

The question as to whether the fungus actually uses only the levulose portion of the glucose formed is very interesting. The quantities dealt with are very small, but all the experiments agree on this point, and there would seem to be no other explanation of the facts.

In a number of cases it has been shown that the inversion of cane sugar, both by plants and animals, is brought about not by any "vital" activity of the protoplasm itself, but by the agency of a definite ferment or enzyme secreted by the protoplasm.* The inverting enzyme is known as "invertase." It has been separated in a number of cases from the organisms producing it, and has been found to retain its power of inverting sucrose. Thus, for example, invertase has been separated from brewers' yeast and from germinating barley. It seems probable that there are a number of different invertases, differing in their activities and resistances to external conditions, but as it is almost impossible to obtain an enzyme in a state of complete purity, some of the observed differences may be due to variations in the impurities.

* For a general account of enzymes, including invertase, see J. Reynolds Green: "Ferments." Cambridge, 1899. Also Effront & Prescott: "Enzymes and their Applications." New York, 1902.

For more recent work on enzyme action, see W. M. Bayliss, "The Nature of Enzyme Action." *Science Progress in the Twentieth Century.* Vol. I., October, 1906.

It seemed advisable, therefore, to attempt to determine whether the inverting action of *Colletotrichum* was likewise due to a production of invertase, and some experiments were carried out with this object in view. It was realized that very little beyond a proof of the presence of invertase could be attempted with the comparatively small amounts of material that would be available, and that anything in the way of an investigation into the properties of the enzyme, if it could be isolated, would be out of the question. There were two points that could be attacked; first, the question whether any invertase could be proved to be produced by the fungus; second, whether, if produced, it is secreted into the medium on which the fungus is growing, or is entirely confined to the mycelium. Butler was unable to secure any inversion by the juice in which *Colletotrichum* had been grown for a week. Apparently he did not attempt to extract the invertase from the mycelium. The experiments to determine whether any invertase is produced will be described first, although the others were carried on simultaneously.

Flask cultures in 20 per cent. sugar solution, with the necessary salts, were used. After a varying number of days the mycelium was strained off (the solution being again filtered and used for the other experiments) and washed. The small quantity of mycelium thus obtained, even from several flasks, was remarkable, and quite prohibited any attempts to separate out the enzyme. It was then thoroughly ground up, either with glass wool or with pure quartz sand; the ground up mass was allowed to stand for some hours, in contact with chloroform water to prevent any bacterial activity, then filtered. The extract was then added to pure sucrose solutions, together with a small quantity of chloroform, and polariscope readings taken daily. A control was always kept of the same sugar solutions with chloroform, to which no extract was added. These experiments were all carried on at room temperature (about 25° C.). The chief difficulty proved to be the getting a solution sufficiently clear to make accurate polariscope readings.

The first experiments gave the following results, the figures representing grams sucrose per 100 c.c. of solution. The readings taken were the average of five:—

	July 11.	July 12.	July 13.	July 15.	July 18.	July 23.
No. 1	16·67	16·46	16·43	16·09	16·04*	—
No. 2	16·20	16·12	16·09	15·91	15·70	15·29
No. 3 (control)	16·26	16·25	16·22	16·22	16·22	16·22

It is thus pretty certain that invertase was contained in the mycelium, and that some of it was abstracted by the grinding. The figures are quite consistent, and show a distinct falling off in the solutions containing the extract.

In the next trial the mycelium was ground for two hours with pure quartz sand in a glass mortar; the mass was then allowed to stand

* Reading uncertain.

over night with chloroform water, then filtered under pressure and finally with alumina cream. The solution was still cloudy, and accurate readings were impossible. However, they showed after three days that there was no falling off in the sucrose. It was hardly conceivable that a mycelium fourteen days old should on that account contain no invertase, while the enzyme had been extracted from one seven days old. The only explanation seemed to be that the invertase had been carried down by the alumina cream in the filtration, although the cream had been added to the extract and not precipitated in it.

The third experiment was with a mycelium three weeks old, the idea being to test the possibility of the invertase varying with the age of the mycelium. The extract after being twice filtered in the ordinary way, was finally cleared by adding shredded filter paper. Sugar was then added to make up to about a 20 per cent. solution, which was then divided into three lots. One of these was heated to 80° C. for a few minutes to destroy the enzyme if any were present, and this served as a control. Chloroform was added to all three. The results were, stated as before, as follows:—

	Sept. 26.	Sept. 27.	Sept. 30.
No. 1 (control)	23·96 ..	23·96 ..	23·99
No. 2	23·96 ..	23·86 ..	23·62
No. 3	23·96 ..	23·86 ..	23·62

These last results are very consistent, and taken with those of the first experiment show clearly that an inverting enzyme is contained in the *Colletotrichum* mycelium, also that the failure of the second experiment to give similar results was probably due to the use of alumina cream which held the invertase.

In the first of the second series of experiments, the clear solution in which the fungus had grown was used to try to separate out the enzyme. Following the method of O'Sullivan and Thompson as described by Reynolds Green, alcohol was added to the solution to a strength of 47 per cent. An appreciable white precipitate was thrown down, allowed to settle, and washed with 47 per cent. alcohol. It was thought that this precipitate must be the enzyme, as there was nothing in the original solution that would be thrown down by alcohol of this strength. The precipitate was, however, soluble only with some difficulty in water. The part which dissolved was added to two flasks of sugar solution, a third part of the same sugar solution being kept as a control. Chloroform was added to all these.

After three days there was no falling off in any of the polariscope readings, proving at all events that the chloroform was a sufficient preservative.

The next experiment was carried out in the same manner, except that the sugar solution had the mycelium growing in it for fourteen instead of seven days. Great care was exercised all through, not in

any way to risk destroying the enzyme. The readings were kept up for four days, during which there was no inversion.

It seemed that the only possible explanation of the inaction, if there were any secretion of invertase, must be that the alcohol had destroyed its inverting power. Invertase is known to be an extremely delicate enzyme, easily injured by a number of chemicals, among them alcohol, but the strength used was supposed to have a minimal effect.

In the next test the solution filtered clear from the mycelium was used without any attempt at precipitation, though it was feared it might be too dilute a solution of the enzyme to give any definite results. About 300 c.c. were taken and sucrose added to make about a 20 per cent. solution. This was divided into three flasks, one of which was then heated to 80°C. for a few minutes, and served as a control. Chloroform was added as before. The results were as follows, the figures being grams per 100 c.c. :—

	Sept. 24.	Sept. 25.	Sept. 26.	Sept. 27.
No. 1 (control)	19·98	19·93	19·93	19·92
No. 2	20·00	19·90	19·71	19·51
No. 3	20·00	19·90	19·71	19·53

The results are thus very consistent, and show a distinct inversion which must be due to invertase. The slight inversion in the first flask may be due to small traces of the invertase not being destroyed by the heating, or to a purely chemical inversion by the salts present.

It was then decided to test the matter further by keeping some of the inverting solutions at a temperature of 40°C. in an incubator. If the inversion were really due to invertase the rate should be considerably higher at the higher temperature. Five flasks were used for this test; No. 1 was the control, Nos. 2 and 3 were kept as before at room temperature, while Nos. 4 and 5 were kept at 40°C. The following results were obtained:—

	Dec. 2.	Dec. 3.	Dec. 4.	Dec 5.
No. 1 (control)	19·52	19·52	19·52	19·46
No. 2	19·52	19·07	18·87	18·65
No. 3	19·52	19·07	18·87	18·65
No. 4	19·52	18·57	18·00	17·37
No. 5	19·52	18·67	18·00	17·37

The results are seen to be even more consistent than was to be expected. In the incubated flasks two and one-half times the amount of sucrose was inverted as in those at 25°C. The experiment, with the last, proves beyond any reasonable doubt that invertase is not only contained in the mycelium of *Colletotrichum* but is actually secreted into the medium in which the fungus is growing.

Treatment.

The principal method of reducing this disease to a minimum is the selection of healthy resistant cuttings; in a few years if every cutting showing any discoloration, especially in the pith, is thrown out, the

disease should be reduced to such cases where infection has taken place from outside.

But in conjunction with selection of cuttings, a selection of resistant varieties must also be carried out. In every recorded outbreak of red rot there has always been one variety which has been severely attacked whilst others have remained entirely or practically free. In Hawaii Yellow Caledonia, as already mentioned, has proved resistant, and would probably be the first variety to be tried in the event of an outbreak.

Finally, there is the question of dealing with the borer, whose wounds form practically the only points at which the cane can get infected from outside. Its control would mean the control of external attacks of red rot, just as seed selection will control internal attacks.

THE "DIAMOND" PATENT CANE CRUSHER ROLLER.

A new type of sugar mill roller designed not long ago and which has now been in operation for two seasons in various cane sugar countries with most successful results, is the "Diamond" Patent Cane Crusher Roller, invented by Mr. H. W. Aitken of Glasgow. As it is stated to have met with considerable success wherever it has been tried, we propose to give here a short description of it and to set forth its principal claims for recognition.

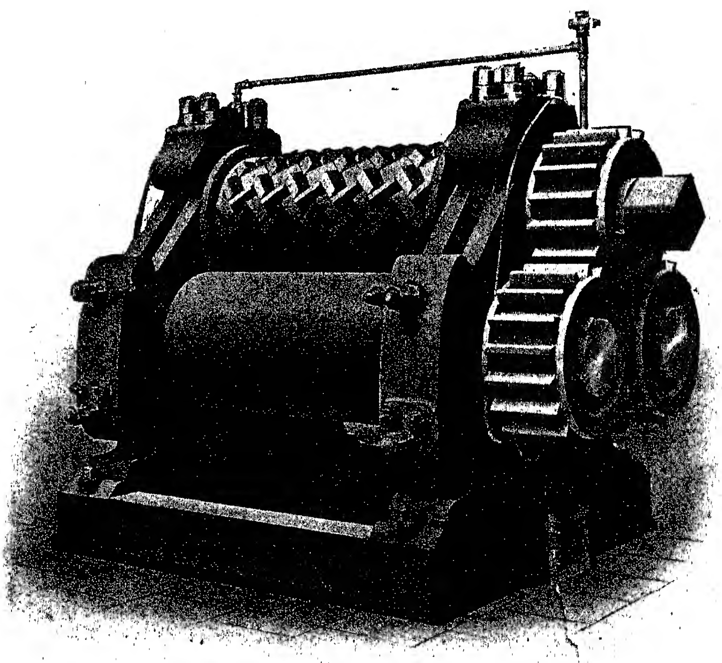
The "Diamond" Patent Roller replaces the usual top roller in a first crushing mill. The crushing surface of the roller is of such a form that a very strong grip of the canes is taken as they enter the mill, so that slipping is impossible and an absolutely uniform feed is maintained. The surface of the roller is embedded in the canes as they pass over the trashturner plate, the crushed canes being carried along with the roller with practically no strain on the trashturner bar. The roller thoroughly splits and breaks up the canes as they pass through the mill, extracts an increased percentage of juice, and puts the crushed canes in the best condition for the absorption of maceration water and for the easy extraction of juice by the second mill.

In designing the "Diamond" Patent Roller, Mr. Aitken aimed at producing a roller that would enable the first crushing mill to take an absolutely certain and uniform feed when grinding either large or small quantities of canes, and at the same time one that would put the bagasse in the best state for imbibition. Mr. Aitken would have been satisfied to have attained these results only, and did not anticipate any further advantages following the adoption of his patent roller. In actual practice, however, it has been proved beyond doubt that the "Diamond" Roller not only increases the extraction of the mill, but that it does so with about two-thirds of the power required with ordinary rollers.

Mr. Koesveld, Administrator of Barongan Estate, Java, writing on 1st June, 1907, says:—

> "With better crushing than before it is now possible, with "two-thirds of the former revolutions of the mill rollers, to mill "the same quantity of canes with the 'Diamond' Roller; a "mill 30 in. × 60 in. can with ease do 12,000 piculs (714 tons) of "cane per 24 hours."

The splitting and breaking-up action in the "Diamond" Roller extends along its entire length, and no canes entering the mill can escape this action. A perfectly free outlet for juice as it is expressed from the canes is also secured. There is no sparkling of juice with the "Diamond" Roller, and it does not take up any of the cush-cush or pulp of the cane.



Practical experience with this roller has also shown that the capacity of the mill can be increased to practically any extent and that the latter continues to work with the greatest regularity and smoothness, liability to break-downs being correspondingly lessened.

Although the functions of a "Diamond" Roller are similar to those of a Krajewski crusher, it has been found advantageous in milling plants having Krajewski crushers which work to their full capacity

to fit a "Diamond" Roller in the first crushing mill. A special design of "Diamond" Roller is now also made for fitting in the second mills of triple crushing plants. These facts shew the great importance that is now attached to securing a perfectly regular feed to the mills.

An important feature in the "Diamond" Roller is the special quality of steel of which it is made, and which experience has shown to be most suitable for this type of roller.

A well-known expert in Java, in reporting on the "Diamond" Patent Roller summarizes its advantages as follows:—

It offers a large increase in capacity; with it the crushing is better than with smooth rollers; the first mill runs quieter and there is therefore less risk of breakage. The second mill receives better prepared bagasse which causes it to choke less frequently, and therefore has also less risk of breakage. Imbibition begins immediately after the first roller. It has a good grip and never slips, and does not squirt the juice; it crushes better down to the lowest layer, and does not take up any of the pulp or juice.

THE CARBONATATION OF BEETROOT JUICES.*

By Eug. Stuyvaert.

I. Preliminary Considerations.

Clarifying Agents.—The manufacture of sugar from the juices of the sugar cane being a much older industry than the extraction of sugar from the beet, it was only natural that, in the early days of the latter, much should have been copied from the more ancient sister industry. The purification of cane juices was effected, in the cane producing colonies, by boiling with lime, and at the commencement of the existence of the industry, beet sugar makers extended this process to the treatment of their juices. Their method was to boil the juice with lime in such quantity that the defecated liquor retained a slight alkalinity at the end of the operation. Soon, however, it was noticed that the composition and concentration of beet juices demanded a modified treatment and a more careful control. At first, lime was used as an epurating agent only for its chemical properties, but it was seen later that, during its removal by carbonic acid gas, physical effects occurred, the action of which was not only to improve the juice, but also to make its subsequent treatment more easy and rapid. In short, during the course of time the original mode of treatment with lime became very greatly modified and improved.

From time to time, it may be remarked, numerous chemicals have been proposed as clarifying agents, claiming to partially or totally

* Contribution to the *Manuel de la Fabrication du Sucre de Betteraves*, edited by the Société Technique et Chimique de Sucrerie de Belgique. Translated by special permission.

replace the use of lime for this purpose; none, however, have survived the test of time, so that this substance still remains the defecator *par excellence* for beetroot juices. This is accounted for by the fact that this reagent has the peculiar property of not only eliminating certain impurities by precipitation, but also of transforming other non-sugar substances into derivatives whose melassigenic action is much less than that of their original form. It may further be explained by the cheapness and abundance of the carbonate of lime, which serves at the same time for the preparation of the lime as for the carbonic acid gas which accomplishes its elimination. Again, its defecatory action is effected by chemical affinity, no exterior form of energy being necessary excepting the heat which, in modern installations, is obtained almost without cost from the concentrating apparatus.

It is for these reasons that calco-carbonic defecation is economically and practically superior to certain other methods which have been proposed, notably to the electrical processes. It is not that methods of electrical treatment for purification, and more particularly the electrodialytic method, are not efficient, for they are capable of giving remarkably well clarified juices, but their restricted value is due principally to the considerable electrical energy required and the loss of sugar which occurs during the working.

There are certain substances, as we shall see later, that can be advantageously used to complete the action of the lime; these may have the effect of a supplementary defecation or of greater decolorization of the juice.

No other substance having been found capable of superseding it, lime remains the basis of the clarification of beet sugar juices, and it is therefore not without interest to study how its use has become modified during the course of time.

Historical.—It has already been indicated that the successful treatment of cane juices by lime did not demand a very careful control as to the amount added; beet juices, on the other hand, defecate very differently, and to bring about the desired effect much greater care must be exercised as to the quantity used and the conditions which obtain. The early workers soon realized that it was necessary to avoid excess, and with this object in view they adopted the system of gradual liming, milk-of-lime being added little by little until a good precipitation was effected. It should be remarked that Achard, at the commencement of the industry, attempted to defecate by means of sulphuric acid, the excess of this reagent being afterwards neutralized by chalk and lime, then the juices thus defecated further purified by boiling with milk or blood. One can readily understand that the use of this substance was not extended, owing to the danger of destruction by inversion of the sugar. Later sulphuric acid was again used in beet sugar manufacture, not this time as a defecating agent but for

the neutralization of the excess of lime. This mode of treatment was recommended by Mathieu de Dombasle about the year 1823; later it was improved by Dubrunfaut, and its use became general until about 1850. The juices were first heated and defecated with lime; the dilute sulphuric acid was then gradually added until the excess of alkali was almost saturated; after decanting and completing the clarification by animal black or blood, the juices were again allowed to settle, being then passed on to the bone-black filters. This process when carefully carried out gave good results, but it was recognized that it was desirable to find another material, cheaper and less dangerous to the sugar than sulphuric acid.

Therefore in 1833 Kuhlmann in France, and a little later Michaëlis and Schatten in Germany, proposed to replace the sulphuric acid by carbonic acid gas, but the early application of the process did not lead to satisfactory results. It was again taken up by Barruel, and was finally brought to a successful issue by Rousseau about the year 1848. After this the method became generally used in sugar factories. The procedure adopted was to add 0·75-1·25 per cent. of milk-of-lime to the juices heated to 60° C., and then to continue heating to 85-95° C.; after decantation, the clear liquors were submitted to the action of carbonic acid until the lime was neutralized, then boiled for a short time, and the precipitate thus thrown out of solution, separated by decantation or filtration.

After an interval of time Rousseau's process underwent modification, and in 1859 Possez and Périer increased the quantity of lime to be added to the juices. These workers had observed that when a large precipitate was produced by the interaction of the carbonic acid in the limed liquors, the carbonate of lime which formed carried down the colouring matters, entrained the other substances and impurities, and left after decantation a clear and well-clarified liquid. As an essential condition of success it was held that the saturation should not be continued too far, for if otherwise the colouring matters, and a certain proportion of the lime precipitated, redissolved. The object they had in view was to considerably reduce the quantities of bone-black generally used at that time. Briefly, their method of procedure was:—The juices previously heated to 60° C. were slowly brought up to 80° C., milk-of-lime to the amount of 2·5 litres per hectolitre being meanwhile added in eight or ten successive portions. After decantation more lime was added; next carbonatation at 60-80° C. followed, and was continued until the alkalinity was equal to 0·1-0·2 of lime. Another decantation followed, and the supernatent liquors were submitted a second time to carbonatation until the greater part of the remaining lime was saturated; the defecated juices were finally boiled and allowed to settle.

Whilst the above described process was in vogue, an Austrian engineer, H. Jelinek, succeeded after a long series of trials in intro-

ducing into the industry a calco-carbonic process of clarification, which was simpler and more readily carried out than that of Possez and Périer. He operated as follows:—The juices at a temperature of 45°C. were treated with 2·5 per cent. of milk of lime, the exact amount being regulated according to the quantity of the juices; immediately afterwards the gas was introduced into the liquors, the temperature meanwhile being raised so that the carbonatation was completed at about 90°C. It will be seen that the advantage this method had over the other was due to the fact that it did away with decantation after defecation, and the clarification was reduced to a single operation.

It must here be stated that the new methods of clarification introduced about the year 1860 owed a large part of their success to mechanical improvements in the means of separating the precipitates formed during the process. It was in 1863 that Jacquier conceived the idea of applying the filter-press, used in England since 1834 in other industries, to the purpose of mechanically separating the sludge from the clarified juices. The use of the press spread rapidly; it not only allowed of the ready separation of the sludges of the defecation and carbonation of the juices, but enabled almost all the sugar held in the voluminous residues of the methods of carbonatation then in use to be easily washed out and recovered.

The introduction of the filter-press, the greater care taken in the carrying out of the calco-carbonic method, the more rigorous chemical control of the several operations, gradually eliminated the use of boneblack, so that at the present time in beet sugar factories it is scarcely ever employed. It is well, however, to point out that mechanical filtration alone is incapable of completely replacing filtration through bone-black. The clarification effected by the first is due only to the elimination of matters held in suspension, whereas with the black, matters in solution are acted upon; but any supplementary clarification that bone-black can give is now generally considered to be out of proportion to its cost in the manufacture of beet sugar.

Another decolorizing agent, sulphurous acid, has little by little come into general use, and when employed judiciously, results approaching those of animal black, with regard to decolorization, can be obtained.

In short, the industry of beetroot sugar at the present time confines itself for the purification of its raw juices to the use of three agents: lime, carbonic acid, and sulphurous acid.

In the lines which follow, their mode of action, their production, and their rational use in the practice of to-day will be discussed.

II. Preliminary Treatment of Juices.

The raw beet juice as it leaves the diffusion battery is cloudy, and of a more or less dark colour according to the time it has been exposed to the air. It holds in suspension some of the cellular tissue of the

beet together with coagulated substances, and contains in solution, besides the sugar, varying quantities of mineral and organic substances. The nature of these foreign "non-sugar" substances hinder the extraction of the sugar in the concentration and crystallization processes of manufacture. In refining the aim is to eliminate these impurities, the greater the degree in which this is successful, the higher will be the *rendement*, and the more rapidly and economically the extraction of the sugar will be realized. It will easily be understood that those substances held in suspension which are capable of interacting with the juice or the lime to form soluble compounds and thus add to the amount of the non-sugar must first be removed; and further that it is necessary to neutralize the destructive action of the natural acids of the juices on the crystallizable sugar, as well as to destroy the influence of the various micro-organisms brought into the factory by the beets and in the water used for diffusion. Again, the juices must be heated to a sufficient temperature to give as efficient a defecation as possible, and to give the best conditions for carbonatation and filtration.

Separation of Pulp.—The pulp separators, as the name implies have as their object the elimination of the particles of beet pulp held in suspension in the juice. The separation of these substances is of much importance to the quality of the defecated juices, and one of the objections to their presence is the fact that they deposit on the heating surfaces of the reheaters, and thus diminish their efficiency. Pulp separators are generally in the form of a vertical cylinder in which is placed a perforated sheet-iron basket; the juice enters the upper part of the receptacle, and the exit pipe is usually at the bottom; between the entrance and exit openings is the perforated basket, through which the juice must pass and deposit the pulp it holds in suspension. The work accomplished is more satisfactory when the holes are small, but the limit must be so adjusted that there is no serious resistance to the discharge of the liquors. When such appliances are used it is necessary, from time to time, to withdraw the basket for the object of cleaning off the accumulated pulp, but a better arrangement is to have two baskets, one being in position while the other is out of use. It is still more advisable, for there is no loss of time, to have two pulp separators so arranged that one or other can be placed in circuit. In many factories a system of pulp separators is used in which the extraction for the purpose of cleaning of the basket is obviated; in these the pulp deposit is removed by a special scraping arrangement, and the juice in its downward course in the basket carries with it the pulp thus detached. The pulp separators are placed between the diffusion batteries and the measuring tanks.

With the object of realizing a more effectual clarification the process of *désalbuminage* has been suggested. When raw juices are heated to a sufficiently high temperature, a portion of the albumenoids

present as well as certain non-nitrogenous substances are coagulated. This fact has caused certain workers to propose the heating of the juices to about 80° C., with subsequent filtration through a special form of filter, the disalbuminator. There are several reasons why this method has been discredited. It has been established, notably by Herzfeld, that the amount of the albumenoids coagulated in this way is proportionately very small and never exceeds 0·1 per cent. of the amount actually contained in the juices; and further, it is pointed out by the same investigator, there is no danger at all of redissolving coagulated albumenoids during the calco-carbonic treatment, and that therefore this idea of the preliminary elimination of these substances in this way is a superfluous one, and based on fundamental error.

(To be continued.)

ABSTRACTS, SCIENTIFIC AND TECHNICAL.*

NITRIFICATION IN ACID SOILS. *A. D. Hall, N. H. J. Miller and C. T. Gimingham. Proc. Roy. Soc., 1908, 80, 196-212.*

Certain of the permanent grass plots at the Rothamsted Experimental Station, which have been manured since 1856 with a mixture of ammonium chloride and ammonium sulphate, have of late years declined in yield, and the herbage has assumed an unhealthy appearance. It was noticed that the soil of these plots was distinctly acid to litmus paper, and as Warington and Winogradsky have shown that nitrification can only proceed in the presence of a salifiable base and that it at once stops in an acid medium, it was believed that the reduced fertility was due to the cessation of nitrification owing to the acid condition of the soil.

The experiments which were made with a view to investigating this showed that the nitrifying organisms were only sparingly present in those soils which had received large amounts of ammonium chloride and ammonium sulphate, that they were the less abundant the more ammonium salts had been used, but that where the acidity of the soil had been reduced by the recent application of lime nitrification was more frequently set up.

Although nitrification still goes on in bulk, despite the acidity of the soil, the amount of nitrate produced would not be sufficient for the nitrogen of the crop, and it is therefore to be concluded that the plants must utilize the ammonium salts directly, without previous nitrification.

The acidity is due to "humic" acids, and free hydrochloric and sulphuric acids are also present. A determination of the extent of the acidity was made by extracting about 7 kilos. on a pressure filter with

successive portions of hot water; no attempt was made to remove a the acid, as this was found to be impossible with water alone. The soil after extraction still reddened blue litmus paper. The soil water showed an acidity equal to 1·71 grms. of hydrogen per million of dry soil; the sulphates and chlorides present were found to amount to 1·91 and 3·15 grms. of hydrogen per million of soil respectively. On extracting the soil with N/5 solution of sodium chloride, the acidity found was 30 grms. hydrogen, and on substituting potassium nitrate for the sodium chloride, 42·5 grms. hydrogen per million of soil was the figure obtained. In these two latter cases the humic acid, which was insoluble in water alone, was also being estimated. The acidity is brought about by various micro-fungi, which are capable of removing ammonia from solutions of its salts, and of setting free the acids with which it was combined.

The authors attribute the continuance of the nitrification in these soils to the presence of particles of calcium carbonate disseminated through them, each of these particles forming a centre for the nitrification process; if, however, the present manurial treatment be continued the soils will be reduced to a uniformly acid condition, under which nitrification may be expected to cease. The unhealthy condition of the plots is due to the fact that their acidity checks the work of the nitrifying and other bacteria and promotes the development of moulds instead; these moulds compete with the grass for the nitrogen compounds supplied as manure, but whether they injure the crop in other ways is under the authors' further investigation.

Süchting's Method for the Estimation of the Acidity of Soils. *A. J. van Schermbeek. Jl. Pract. Chem., 1908, 77, 489-497.*

Süchting's modification of Tacke's method for the estimation of the acidity of soils (this *Jl.* 1908, 254-255) is adversely criticised. No allowance is made, the author of the present paper points out, for the presence of carbon dioxide in the soil, the formation of other free acids is not prevented, and the figure obtained is in no way an indication of the true acidity of the soil.

Volumetric Determination of Reducing Sugars. Part II.—The Limits of Accuracy of the Method. *A. R. Ling and G. Cecil Jones. Analyst, 1908, 33, 160-167.*

In a previous paper (*Analyst, 1905, 30, 182*) a modification of estimating reducing sugars by Fehling's solution, based on the use of ferrous thiocyanate as indicator, was described by the authors. This method was recommended mainly on account of its greater accuracy as compared with the one usually adopted of titrating sugars with Fehling's solution, using potassium ferrocyanide as indicator. In the present paper, the limits of accuracy of the method

under the standard conditions prescribed, are investigated and compared with results obtained by means of the gravimetric method.

Using solutions of dextrose, laevulose and maltose of known concentrations, it is shown that the average error of the method is, in the case of dextrose and invert sugar, 1 in 400, of maltose, 1 in 300, and of laevulose, 1 in 100, the average thus being about 1 in 300.

In the gravimetric method, the average error (using Brown, Morris and Millar's figures, *Jl. Chem. Soc. Trans.*, *1897*, *71*, *280*) is, in the case of dextrose, 1 in 250, of laevulose, 1 in 300, and of maltose, 0·5 per cent.

It may therefore be concluded that this method is not only much more rapid but quite as accurate as the gravimetric one.

In the previous paper the proportion of hydrochloric acid was wrongly given. The following gives the most satisfactory indicator: Ammonium thiocyanate, 1·5 grm.; ferrous ammonium sulphate, 1·0 grm.; conc. hydrochloric acid, 2·5 c.c.; water, 10·0 c.c., the solution thus obtained being decolorized by the addition of a small quantity of zinc dust. In titrating, about a dozen small drops of the indicator are placed on a glazed porcelain tile or opal glass slab, and a drop of the assay liquid removed from the titration flask by means of a glass rod, and brought in contact with the middle of one of the drops. It is necessary to perform the test as rapidly as possible.

VOLUMETRIC DETERMINATION OF REDUCING SUGARS. PART III.—THE DETERMINATION OF SUCROSE AND INVERT SUGAR IN MIXTURES. *A. R. Ling and T. Rendle. Analyst*, *1908*, *33*, *167-173*.

Although sucrose is by constitution a non-reducing sugar, it is well known that it is capable of reducing Fehling's solution to a certain extent when boiled with it; it is therefore necessary when examining mixtures of sucrose and invert sugar, such as raw sugars, cane molasses and cane syrups, to apply a correction when estimating invert sugar by any method involving cupric reduction. Meissl, Herzfeld, Zulkowski and others have drawn up tables giving corrections for the influence of sucrose in mixtures of the two sugars, but these all refer to the particular method used in each case.

In this paper the authors record the data necessary for correcting the results obtained by their method previously described (*Analyst*, *1905*, *30*, *182*). The solutions operated upon contained 0·15, 0·20 and and 0·25 grms. of invert sugar per 100 c.c. and varying amounts of sucrose. It was shown that the influence of sucrose is practically negligable until the proportions on the total sugars amounts to 30 per cent., and that the influence of the sucrose increases progressively in the same direction until the proportion, expressed on the total sugars, of 99·3 per cent. is reached, at which point the invert sugar

is over-estimated to the extent of 15 per cent. Thus, for example, in the case of a mixture of equal parts of sucrose and invert sugar, the amount of the latter would be given as 50·4 instead of 50·0 per cent., *i.e.*, it would be over-estimated by 0·8 per cent.; whilst in the case of a mixture containing 99·0 per cent. of sucrose and 1·0 per cent. of invert sugar, the latter would be returned as 1·14 per cent. instead of 1·0 per cent., being this over-estimated to the extent of 14·0 per cent.

The tables, which are given for applying these corrections when using the authors' method, are drawn up for concentrations of 0·15, 0·20 and 0·25 grms. invert sugar per 100 c.c.

COMPARATIVE INVESTIGATIONS ON VARIOUS METHODS FOR THE DETERMINATION OF DEXTROSE. *Tösaku Kinoshita. Biochem. Zeitsch.*, *1908*, *9*, *208-230.*

The methods investigated were those of (1) Allihn; (2) Knapp; (3) the Kumaguwa-Suto modification of Pavy. It was found with each process that the most reliable results were obtained when working with a concentration of 0·2 per cent. of dextrose. The mean error in the Allihn and modified Pavy methods was shown to be 0·04 per cent. and 0·02 per cent. respectively, whereas in Knapp's process this amounted to 1·73 per cent. Preference is given to the Pavy-Kumaguwa-Suto method owing to the readiness with which it can be carried out.

DETERMINATION OF SUGAR BY THE ALLIHN OR MEISSL METHOD. *H. Schaumann. Zeitsch. Anal. Chem.*, *1908*, *47*, *235-237.*

In order to avoid the troublesome manipulation of the hot porcelain dish involved in the transference of the cuprous oxide to the filter tube in the Allihn or Meissl method of estimating sugar, the author uses a convenient arrangement in which, first the supernatent liquid, then the precipitate itself is sucked from the dish through a piece of glass tubing directly into the filter tube.

EXPERIMENTS ON THE ELECTRO-CHEMICAL DETERMINATION OF ALKALINITY. *A. E. Lange. Zeit. Ver. deut. Zuckerind.*, *1908*, *453-468.*

As a result of these experiments it is concluded that:—

(1) The determination of the neutral point by the electro conductivity and concentration cell methods does not give results in accordance with those obtained by the use of the ordinary indicators; phenol-phthalein, however, gives figures in fairly close agreement.

(2) The acidity or alkalinity of chemically pure solutions of cane sugar can readily and accurately be determined by both the above-mentioned electro-chemical methods.

(3) With raw sugars, or pure sucrose solutions to which molasses has been added, trustworthy results cannot be obtained by reason of the interference of the impurities.

(4) Phenol-phthalein is the most reliable indicator to use for the determination of the alkalinity of raw sugars.

UTILIZATION OF THE BY-PRODUCTS OF THE SUGAR INDUSTRY. *E. Lemaire. Le Génie Civil, 51, 199-202, 218-220, 233-235.*

The utilization of the by-products of the beetroot sugar and fermentation industries are discussed in a long series of articles; each of the processes is described in detail and drawings of plant are given. The most successful are those of:—

(1) Vincent, in which the evaporated molasses is subjected to dry distillation, the volatile products (ammonia, methylamides and methyl-alcohol) collected, and the potash lixiviated from the residue.

(2) Vasseux, which consists in converting the spent wash, after the removal of the greater part of the potash by dilute sulphuric acid, into a nitrogenous organic manure by drying *in vacuo*, the ammoniacal tarry and glycerine substances, which distil off, being recovered. The products thus obtained contain 5-6 per cent. of nitrogen (0·023 per cent. as ammonia, the remainder as amides), and 6-7 per cent. of potash. The nitrogen has been proved to exist in a form capable of ready nitrification, and the result is a product which is claimed to be superior to farmyard, and but little inferior to artificial, manure.

(3) Rivière, which heats the spent molasses or wash with lime under pressure to liberate the nitrogen existing as ammonia, and then with hydrofluosilicic acid to precipitate the potash. The potassium fluosilicate is heated in an autoclave with lime, and calcium fluoride and potassium silicate obtained; the former is separated and the hydrofluoric acid recovered from it by distillation with sulphuric acid; the latter is heated with carbon dioxide to give silica and potassium carbonate; the hydrofluoric acid and silica serve for the regeneration of a supply of hydrofluosilicic acid for further use.

(4) Sperber, Büttner and Meyer, Petry and Hecking, and others, who transform beetroot cossettes into cattle food by drying with steam or furnace gases; this method of treatment has been in use in Germany and Austria for some time and is now becoming general in France. Sometimes the food value of the pulp is increased by incorporation with molasses, the addition being made either before or after drying.

(5) Venator and Bueb, in which residuary molasses is dry distilled and the gaseous products heated to a high temperature, the nitrogen being transformed in this way into ammonium cyanide.

Other subjects are :—

SOURCES OF ERROR IN THE DETERMINATION OF THE SUGAR CONTENT OF THE BEETROOT. *H. Zscheye. Zeit. Ver. Deut. Zuckerind., 1908, 437-441.*

USE OF HYDROSULPHITE ("BLANKIT") IN THE SUGAR INDUSTRY. *E. Ziebold and H. Gutherz. Böhm. Zeit. Zuckerind., 1908, 32, 468-472.*

KOWALSKI-KOZAKOWSKI PROCESS. *H. Ruhnke, D. Zuckerind., 1908, 32, 427; and J. Weisberg, Circ. hebdom. Synd., 1908, 998.*

DEPOSITS IN MULTIPLE EFFECTS. *H. Peck. D. Zuckerind., 1908, 32, 471.*

DATA OF REFINERY CONTROL. *E. Ziebold and H. Gutherz. Öester-ungar. Zeit. Zuckerind., 1908, 37, 203.*

SOURCES OF ERROR IN BEETROOT ANALYSIS. *A. Herzfeld. D. Zuckerind., 1908, 32, 432.*

INFLUENCE OF PENTOSANS IN THE DIFFUSION BATTERIES. *S. Levitski. Centr. Zuckerind., 1908, 16, 948.*

SUGAR MANUFACTURE IN THE EAST INDIES. *Walter. Centr. Zuckerind., 1908, 16, 471.*

PUBLICATIONS RECEIVED.

RECIPES FOR THE PRESERVING OF FRUIT, VEGETABLES, AND MEAT. By E. Wagner. Translated from the German by Charles Salter. With 14 illustrations. Crown 8vo., 125 pp. 5s. net. Scott, Greenwood & Co., London. New York: D. van Nostrand Co.

This small work is from the pen of the technical Manager of the Preserving and Marmalade Departments of the Trachenburg Sugar Boiling Works, who has had a practical experience of over 30 years. It is, however, too advanced for any but professional preserve makers, as the methods of testing are of a scientific order. Such phrases as "The fruit is covered with 20° sugar" would be beyond the comprehension of any ordinary readers. But for those who already possess a knowledge of the technics of the subject, the book will doubtless prove of a profitable nature, and though English preserve makers are among the very best, they may still learn something from continental practice.

A new Central has just been ordered for Jamaica to be erected in Westmoreland Parish on the estate of the Hon. W. A. S. Vickers. The Mirrlees Watson Company, Limited, of Glasgow, have secured the contract. The grinding plant will consist of two 28 in. × 54 in. mills preceded by a Krajewski Crusher, all driven by one engine. This same firm have just shipped a crushing plant to Java, consisting of a train of four three-roller mills, 34 in. × 78 in., preceded by a Krajewski Crusher, which the makers claim to be the largest plant ever built in this country.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of May, 1907 and 1908.

IMPORTS.

Raw Sugars.	Quantities.		Values.	
	1907. Cwts.	1908. Cwts.	1907. £	1908. £
Germany	3,864,508	3,115,752	1,794,580	1,639,680
Holland	69,254	97,652	29,919	48,333
Belgium	177,265	59,014	78,549	29,385
France	167,302	116,935	83,764	69,901
Austria-Hungary	255,675	393,107	115,127	210,221
Java	64,194	318,152	33,230	172,230
Philippine Islands	68,689	167,860	28,500	66,997
Cuba	91,113	....	39,600	....
Peru	215,234	524,527	102,335	280,675
Brazil	184,891	1,712	76,346	788
Argentine Republic	....	....	....	....
Mauritius	282,237	226,805	116,614	99,946
British East Indies	15,378	86,121	6,403	37,345
Straits Settlements	87,239	69,003	36,610	30,631
Br. W. Indies, Guiana, &c.	811,632	571,086	469,364	406,597
Other Countries	435,424	402,927	215,574	224,310
Total Raw Sugars	6,790,035	6,150,653	3,226,515	3,317,039
Refined Sugars.				
Germany	5,447,209	5,806,682	3,191,621	3,703,874
Holland	1,146,564	1,004,715	715,487	674,630
Belgium	134,252	78,107	81,296	50,334
France	1,494,910	673,079	865,789	438,052
Other Countries	489	68,309	365	45,375
Total Refined Sugars	8,223,424	7,630,892	4,854,558	4,912,265
Molasses	1,140,802	1,012,975	217,428	202,160
Total Imports	16,154,261	14,794,520	8,298,501	8,431,464

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	192	666	125	274
Norway	6,553	4,910	3,883	3,149
Denmark	40,608	41,462	21,071	24,807
Holland	31,285	27,742	20,790	19,770
Belgium	3,970	3,278	2,363	2,244
Portugal, Azores, &c.	13,010	5,717	7,154	3,431
Italy	10,137	4,068	5,298	2,408
Other Countries	164,605	100,956	120,947	78,940
	270,360	188,799	181,631	135,023
Foreign & Colonial Sugars				
Refined and Candy	7,611	6,790	5,463	5,120
Unrefined	34,601	32,573	21,030	20,558
Molasses	4,031	468	1,161	148
Total Exports	316,603	228,630	209,285	160,849

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1908. Tons.		1907. Tons.
Total Receipts Jan. 1st to June 18th ..	1,042,747	..	1,160,533
Receipts of Refined ,, ,, ...	610	..	420
Deliveries ,, ,, ...	1,024,002	..	1,117,104
Importers' Stocks, June 17th	24,363	..	43,429
Total Stocks, June 24th	309,000	..	441,880
Stocks in Cuba, ,, ...	129,000	..	236,000
	1907.		1906.
Total Consumption for twelve months..	2,993,979	..	2,864,013

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1907 AND 1908.

(Tons of 2,240lbs.)	1907. Tons.		1908. Tons.
Exports	971,749	..	707,622
Stocks	382,045	..	177,411
	1,343,794	..	885,033
Local Consumption (5 months)	19,870	..	24,540
	1,363,664	..	909,573
Stock on 1st January (old crop)	....	..	9,318
Receipts at Ports up to May 31st	1,363,664	..	900,255

Havana, May 31st, 1908. J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR FIVE MONTHS, ENDING MAY 31ST, 1908.

SUGAR.	Imports. 1906. Tons.	Imports. 1907. Tons.	Imports. 1908. Tons.	Exports (Foreign). 1906. Tons.	Exports (Foreign). 1907. Tons.	Exports (Foreign). 1908. Tons.
Refined	341,517	411,171	381,545	681	380	339
Raw	355,295	339,502	307,533	5,071	1,730	1,629
Molasses	57,226	57,040	50,649	259	202	23
Total.........	754,038	807,713	739,727	6,011	2,312	1,991

	Home Consumption. 1906. Tons.		1907. Tons.		1908. Tons.
Refined..	328,000	..	384,973	..	357,307
Refined (in Bond) in the United Kingdom	229,102	..	205,829	..	210,341
Raw	49,820	..	48,149	..	46,148
Molasses	55,044	..	50,756	..	52,948
Molasses, manufactured (in Bond) in U.K.	27,965	..	29,620	..	30,014
Total	689,931	..	719,327	..	696,758
Less Exports of British Refined......................	18,566	..	13,518	..	9,440
Total Home Consumption of Sugar	671,365	..	705,809	..	687,318

STOCKS OF SUGAR IN EUROPE AT UNEVEN DATES, JUNE 1ST TO 20TH. COMPARED WITH PREVIOUS YEARS.

IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	TOTAL 1908.
197	725	403	486	119	1930

	1907.	1906.	1905.	1904.
Totals	2073 ..	2437 ..	1722 ..	2256

TWELVE MONTHS' CONSUMPTION OF SUGAR IN EUROPE FOR THREE YEARS, ENDING MAY 31ST, IN THOUSANDS OF TONS.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria-Hungary	Holland, Belgium, &c.	Total 1907-08.	Total 1906-07.	Total 1905-06.
1841	1176	652	546	198	4415	4541	4068

ESTIMATED CROP OF BEETROOT SUGAR ON THE CONTINENT OF EUROPE FOR THE CURRENT CAMPAIGN, COMPARED WITH THE ACTUAL CROP OF THE THREE PREVIOUS CAMPAIGNS.

(From Licht's Monthly Circular.)

	1907-1908. Tons.	1906-1907. Tons.	1905-1906. Tons.	1904-1905. Tons.
Germany	2,132,000 ..	2,239,179 ..	2,418,156 ..	1,598,164
Austria	1,430,000 ..	1,343,940 ..	1,509,789 ..	889,431
France	725,000 ..	756,094 ..	1,089,684 ..	622,422
Russia	1,410,000 ..	1,440,130 ..	968,500 ..	953,626
Belgium	235,000 ..	282,804 ..	328,770 ..	176,466
Holland	175,000 ..	181,417 ..	207,189 ..	136,551
Other Countries .	435,000 ..	467,244 ..	410,255 ..	332,098
	6,542,000	6,710,808	6,932,343	4,708,758

THE

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☞ All communications to be addressed to the Editor, Office of "The Sugar Cane," Altrincham, near Manchester.

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The Editor will be glad to consider any MSS. sent to him for insertion in this Journal and will endeavour to return the same if unsuitable; but he cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

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NOTICE TO READERS.—If the Advertisement pages stick together, bang their edges on the table, when they should easily separate.

NOTES AND COMMENTS.

The Sugar Convention and "Refining in Bond."

It has always been the impression that, with the exception of France, the other Powers who are parties to the Convention have strictly carried out the Article which prescribes refining in bond. The object of that Article is to abolish the payment of drawbacks on exportation, a system which, in former times, led to great abuses and to heavy bounties on the exportation of refined sugar. As we have often had occasion to point out and explain, France obstinately refuses to establish refining in bond. This has been brought before the Permanent Commission on more than one occasion, but the British Delegate has failed to obtain support from the other members of the Commission in pressing his protest. This has always appeared strange, because it might be supposed that Germany, Austria, Holland and Belgium, who export large quantities of refined sugar, would be the first to oppose and protest against any failure on the part of France to make the payment of bounties on the exportation of refined sugar an impossibility.

Great Britain has strictly carried out the system of refining in bond. No duty is paid on the raw sugar entering a British refinery, and, therefore, no drawback is paid on the exportation of refined sugar. It was supposed that the same system was strictly carried out

in Germany, Austria, Holland and Belgium. But the intelligence furnished in the *Journal des Fabricants de Sucre* of the 22nd July raises some doubts on this point. The information runs as follows:—

"It is announced that the German refiners have expressed the wish to be authorised to refine in bond, from the 1st September, 1908, Russian sugar, alleging, in support of this demand, the fact that the Dutch refiners have already bought 25,000 tons of Russian sugar, with the view of refining them in bond, an operation which has been authorised by the Dutch Government."

Here is somewhat of an enigma. If refining in bond were the system in operation in Germany and Holland, it would not be necessary to apply to the Government for leave to use Russian sugar on condition that it was refined in bond. It would be refined in bond as a matter of course. In that case the form of the application to the Government would simply be a request for permission to import Russian sugar for refining and subsequent exportation.

It would be well that the British Government should ask for explanations.

Is Sugar the Fetish of British Guiana?

It has long been a patent fact that the Demerara sugar industry is not as a whole in a flourishing condition, and that the sooner some radical improvement is made, the better for that colony. Reports lately to hand show no promise of improvement, and are decidedly gloomy. One or two well established firms may still be making good profits, but the condition of the majority of the smaller estates can hardly be a matter for satisfaction. That even the Demeraraus are beginning to realize this is clear from the fact that a warning note on the subject was recently contributed by an anonymous writer to the *Demerara Chronicle*, which was of such a striking nature that we feel disposed to quote from it. The writer, after stating that "nations or people retrogress when they fail to make use of the gifts God has provided, when some fetish rules over the land, and you hear but one word, 'Kismet;' and when energy and progress are conspicuous by their absence, and apathy and listlessness and dry rot have taken their places," goes on to insist that sugar is the fetish of British Guiana to-day.

"Sugar that in the hey-day of its prosperity omitted to do ought to advance the interests of the colony's development, to open it out to build lines of communication, to increase and attract population, and thus lessen the material charges on itself; sugar that failed in the foresight of coming competition, and made no provision for the economic conditions created by its rivals; sugar that views with suspicion and distrust any and every industry that ventures to set foot in the colony, and is unable to see that the material growth and prosperity of the colony means the enhancing of sugar values and interests; sugar that cries out against any and every industry or important project that 'You will ruin our labour,' as if the resources of

civilisation were exhausted for the protection of their labour; sugar that sits down and bemoans and bewails its fate, and makes no determined effort to realise the last possible word in the economic production of the same.

"Throughout Germany and France the foremost chemists are studying and working at, experimenting day in, day out, week in, week out, year after year, to see in what possible way the cost of production can be still further reduced, if not infinitesimally. Is there a planter in British Guiana who would have the temerity to assert that any resolute and prolonged attempt at the scientific production of sugar, at the irreducible minimum of cost has been made? It is doubtful. Are not the same old methods and systems in use? It would appear so. And yet sugar, instead of recognising its own duties and responsibilities to the colony, all of whose other resources have been sacrificed to the interests of sugar, with a consistency worthy of a better cause, maintains an illogical and unjustifiable hostility to new enterprises. Why? There is no possible explanation outside of fetish worship, the practice of which has been the ruin of many more powerful communities than that of British Guiana."

Comparison is made with the case of cotton in the Southern States, which was previous to the Civil War the fetish there, to the exclusion of all other industries. But, after the war, new blood came in with capital behind it; iron and coal mines were opened out, hundreds of industries started, and the cotton industry itself increased by leaps and bounds, stimulated by the competition around it, which forced the planters to abandon old ideas and bring new methods into play. The result is, that whereas at the time the fetish was reigning supreme four million bales a year was the output, now it is 12½ million bales!

The writer of the article under review contrasts this strongly with British Guiana's experience; indeed, he declares that the latter's policy, as "pursued by them in the past, was a mistake, and that if their industry is to be reinstated to its ancient glory it can only be done by a system of economic working based upon the latest and most up-to-date methods of scientific production; and secondly, by encouraging the development of the colony through public works and new industries; and finally, by abandoning once and for all the idea that any new project—public works or industry—must of necessity be injurious to sugar."

These are strong words, and they may rouse some resentment in quarters where some attempt has been made to keep abreast of the times. But coming as it does from an inside source, there is no doubt sufficient justification for the charge to warrant its careful consideration. After all, it is not that British Guiana has done badly, but that she has not made the most of her opportunities. She had some excuse for a *laissez-faire* policy when the bounties were paralysing her premier industry; but now they are a thing of the past, it certainly behoves her to do the best she can to tap all her sources of wealth and work them on the most scientific principles.

Japanese Requirements.

Some short time ago the Japan Sugar Refining Company found it advisable to instruct its Java representative to draw up a circular to send round to the Java sugar manufacturers and sugar exporters who supplied the Japanese Company with raw sugar. They were told (1) not to use caramel or any other artificial colour, but to leave the sugar in its natural colour; (2) not to mix the sugar with second syrups in any large quantity, in other words first boilings only were desired; (3) large, uniform and regular crystals were desired; (4) to pack the sugar in strong baskets of equal size and weight; (5) to pay attention not to mix the sugar with stones two-fifths inch in diameter, such as were found in baskets delivered from Java; (6) to give the preference to "Golden Bloom" for artificial colouring, such as is used in England and some other countries.*

On analysis these Japanese demands will appear to the impartial reader to be somewhat arbitrary; and the tone, especially as regards the reference to the stones, is hardly dignified. They ask for sugar entirely from first syrups without any returned molasses. If they can get them, well, but can they? We think we are not mistaken in asserting that it is an impossible demand, as no other source of supply open to the Japanese will turn out exclusively such sugar; so that it is hardly to be expected that the Java manufacturers will abandon their particular manufacturing process without some substantial reason. As to the stones, if Mr. Shimamura, the Japanese representative, knew the origin of them, as we think he did, he was scarcely well-advised to pose as a humorist and suggest that the Java manufacturers mixed such objects with their sugar as a matter of course. For it is clear these very occasional accidents arose during the transit of the finished sugar from the factory to the railway. Such factories as have not railway siding accommodation have to send their sugar to the station in open bullock carts. On its way thither it will happen now and then that sugar is stolen by the coolies, and as the baskets are weighed when leaving the factory and again on delivery, the thieves make up for the deficit in weight by adding stones picked up from the roadside. Naturally this cannot be detected at the time, and may only be found out later on when some stirrer arms get broken by contact with those stones, much to the annoyance of the refinery authorities. This is certainly a very unpleasant experience, but, as far as our information goes, is nevertheless a comparatively rare one. At all events we think the requirements of the case would have been better met by a request to the Java manufacturers to try and keep a closer watch over the coolies, or, better still, to devise some method of sealing the baskets so that their contents cannot be

* This last which rather clashes with Instruction No. 1 evidently refers to Newland's "Golden Bloom" which is an extract of campeche wood and was substituted for "Bloomer" or tin chloride in making Demerara sugar when complaints were raised as to the injurious nature of the tin.

tampered with. But, instead, we are treated to a rather naïve request which seems to have provided no little merriment in sugar circles all over the world.

Penguins' Eggs.

The Government of the Cape of Good Hope is endeavouring to secure a market in the United Kingdom for the sale of penguins' eggs, which as delicacies are considered similar in texture and flavour to large plovers' eggs. The penguin rookeries are situated on some islands off the Cape coast, and the eggs are shipped to Europe in cold storage, which keeps them fresh. So far in this country they have only been the food of the epicure and gourmet, but serious attempts are being made to extend their consumption; in South Africa they are consumed by all classes of the community. The eggs are best eaten either boiled or scrambled. They should be boiled from 15 to 20 minutes. When served scrambled they taste as if fish were the principal ingredient. It may be added that they are among the most nourishing and easily digested eggs known. We believe Messrs. Sprigens & Son, Leadenhall Market, London, are the principal agents for their sale in England.

The Cuban-American Sugar Company.

It is announced that the Cuban-American Sugar Company, said to be the largest producers of raw sugar in the world, have absorbed the Colonial Sugar Company of Cuba and Lousiana. The Cuban-American Company was incorporated in September, 1906, for taking over the following companies; Chappara Sugar Company, Tinguaro Sugar Company, Cuba Sugar Refining Company, Unidad Sugar Company, and Mercidita Sugar Company. The Colonial Sugar Company is a consolidation of the Gramacy Sugar Company, The Gramacy Finance Company and the Damuji Company. It has a refinery at Gramacy, La, a central factory of large capacity, and four sugar plantations of 6800 acres. In Cuba the Company owns 55,000 acres of land, of which 13,000 are under cultivation, as well as machinery capable of dealing with 250,000 tons of cane in the season. The new combined company is likely to prove a powerful factor in the sugar interests of the States.

The Demerara Company.

We understand that the partnership of Messrs. J. E. Tinne, C. S. Parker, E. S. Parker, and J. A. Tinne, under the style of Sandbach, Tinne & Co., of Liverpool and London, and Sandbach, Parker & Co., of Demerara, has lately been dissolved as far as Mr. Charles Sandbach Parker is concerned, in order that the latter may take up the management in London of the newly formed Demerara Company Ltd., which owns Plantations "Diamond" and "Wales" in Demerara.

The remaining partners will carry on as heretofore the businesses of of the two first-named firms, and will in addition act as Liverpool and Demerara agents respectively of the Demerara Company Ltd. The latter's new offices are situated at St. Dunstan's Hill, E.C

Amongst the new Birthday Baronets gazetted in June was Mr. Hudson Ewbanke Kearley, M.P., whose name will be familiar to many of our readers as a doughty opponent of the Sugar Convention. His persistent attacks on that measure when the Liberals were in opposition were bound to meet with their reward, and, on the accession of his party to power, he was created Parliamentary Secretary to the Board of Trade in 1905. Since his acceptance of office he has shown some considerable ability, and has wisely refrained from letting his prejudices run riot to the detriment of discipline; one of his contemporaries of opposition days, who likewise earned a Government post, but was less disposed to control himself, is now retired from office with the bare consolation of a Privy Councillorship. Sir H. E. Kearley, Bart., M.P., is the head of a prosperous firm of provision merchants.

Mr. ASQUITH AND THE SUGAR CONVENTION.

Mr. Villiers, the newest leader of the great pro-bounty free trade party, seems to have got himself into hot water at the monster deputation to Mr. Asquith on the 14th July.

Opening the ball, Mr. Villiers, in his excess of vigour, received a sad rebuff. "The Liberal Government," he declared, "which was looked upon as the champion of free trade, and which owed its present power and position to free trade, had, by renewing the Convention, thrown over and betrayed that most cherished principle." That was the first count in his inditement. The second was that the Government, "in attempting to renew the Convention without consulting Parliament, had infringed the rights of the House of Commons." Thirdly, "the Government, by its action, had violated the Constitution." Loud cries of dissent from the members of the deputation, and a stern rebuke from Mr. Asquith, was all that Mr. Villiers got for this brave sally. He humbly asked for a day to discuss the question and promptly sat down.

Mr. Asquith had no difficulty in replying. The policy of the Government, he said, had been announced by Sir Edward Grey in the House of Commons on the 6th June, last year, and no objection had been raised. "If the other Powers were content to drop what were called the penal clauses of the Brussels Convention they were prepared to negotiate with them for a continuance of that Convention." That most explicit statement "they had every reason to

believe was accepted as consistent with the pledges and known convictions of the Liberal party." "The principal clause in that Convention—*the only clause which gave it any validity*—was one which required them, at the bidding of a tribunal in which the sugar-producing Powers were always in a majority, either by countervailing duties or by prohibition, to exclude from their markets sugar which came from other countries giving bounties to sugar production." The negotiations resulted in the other Powers agreeing to this proposal. There was nothing else in the Convention which was contrary to their free trade principles. As to submitting the revised Convention for the assent of Parliament, it was well-known that that assent was not necessary in the case of the treaty-making powers of the Crown unless "something had to be done which, without Parliamentary sanction, would be illegal." No such necessity arose in the present case. Finally, as to the restriction of the exports from Russia, Mr. Asquith promptly disposed of any objection on that score in the following words:—

"Let it be clearly understood that if Russia choose to send any quantity of sugar into their markets there was nothing in the Convention to debar them from receiving every ounce of it."

Thus did Mr. Asquith shatter every impotent missile which his friends had gathered round to pelt him with. They withdrew, but not to silence and obscurity. On the following day they had a dinner, and loudly declared that their repulse was only a temporary reverse, and that they would return to the charge and march to victory. According to Mr. Lough, "Mr. Asquith's speech to the deputation was the worst speech ever made by a free trade Prime Minister." "The Government had been led into taking a false step in order to oblige foreign Powers. He was a man of peace, and no one was willing to make greater sacrifices for the cause of peace than himself, but in a matter of trade like this there should be no shadow of yielding."

Mr. Lough evidently means war to the knife. On the 21st July they had a meeting and decided to insist on having a day for further discussion of the matter in the House of Commons. The debate at Whitsuntide, when Sir Edward Grey made a full statement of the case for the Government, followed by the deputation of the 14th July, when the Prime Minister made a further declaration of the action of the Government, is not sufficient for Mr. Lough and his friends. Their complaints have been torn to shreds, the defence of the Government has been complete and unanswerable from their point of view, and yet Mr. Lough and Mr. Villiers are spoiling for the fray, and eager for a few more knock-down blows.

The Times, in a humorous leading article, likens them to the poor benighted savage who, "getting angry with his little wooden god,

takes the erring idol from its niche and gives it a sound thrashing, without prejudice to resumption of an attitude of fearful veneration." That attitude is not to come just yet, the erring idol is to have one more sound thrashing, in spite of the fact that the previous castigations have been, as the schoolmaster used to say, more painful to the giver than to the receiver of the punishment.

RAPID TRANSFORMATION OF STARCH INTO SUCROSE DURING THE RIPENING OF SOME TROPICAL FRUITS.

By H. C. Prinsen Geerligs.

Some tropical fruits which as a rule are gathered in a green and immature state and allowed to ripen afterwards, accomplish this ripening process so rapidly that within a few days they become tender, well-flavoured, and palatable, thus offering a good opportunity for studying the still somewhat mysterious problem of the after-ripening of fruits.

I. Phenomena observed during After-ripening.

(*a*) *Banana* (*Musa*).

As a rule the bunches of bananas, which contain fruits in various stages of maturity, are cut from the plant as a whole and are hung up to ripen. At the moment when the bunch is cut none of the bananas are fit for food; they are hard, tasteless, and flavourless; the skin is thick, contains much latex and tannin, and firmly adheres to the fleshy part. After a few days the skin becomes thin and yellow and can easily be detached, whilst the edible matter is now tender, sweet, and well-flavoured. A couple of days afterwards the fruit is again unpalatable owing to overripeness and decay, which convert it into a soft mass.

This after-ripening is accompanied by a considerable loss of weight as is shown by the following figures:—

20 bananas broken from the bunch in a green state were placed in a relatively cool spot (28° C.) and weighed daily. The average weight per fruit was after

0	1	2	3	4	5	6	7	days.
145	143	142·5	142	141	139	138	137	grammes.

Further, 10 green bananas of another variety were placed under a glass bell jar into which a current of air free from carbonic acid was introduced. The air leaving the bell jar was compelled to pass through a drying apparatus and a Liebig potash bulb, which latter was weighed daily.

	Grammes.
The fruits weighed originally	502·5
And after four days	487·
They therefore lost in weight	15·5
The weight of the potash bulb increased—	
The first day by	0·065
The second day by	1·455
The third day by	0·540
The fourth day by	0·240
Total increase	2·300

So that the fruits gave off 2·3 grammes or 0·44% of carbonic acid in four days.

The chemical changes taking place during the after-ripening process were then studied. Each day a banana was broken off from a green unripe bunch of the fruit and when doing this care was taken to select the specimen from the same side of the bunch from which the previous one had been taken and thus to obtain samples of the same initial ripeness. The fruit was first peeled and rubbed to pulp in a mortar. The moisture was then determined in 10 grammes of this by dessication to a constant weight. Next 100 grammes of the pulp were extracted with alcohol, and the residue dried and weighed. The alcoholic solution was evaporated after adding a little calcium carbonate with the object of neutralizing the acids and preventing inversion. The remaining residue was dissolved in water to which was added a small quantity of a solution of neutral lead acetate and made up with water to the volume of 100 c.cm., in order to get the sugars in the solutions at the same concentration as that in which they were originally present in the pulp. The polarization and reducing sugars in the solution were determined both before and after inversion, and the amount of sucrose, glucose and fructose was calculated from the figures thus obtained after ascertaining that no other sugars were present in the liquid. The dry residue left behind after the alcoholic extraction of the pulp was pulverized and part of it extracted with cold water. The extract was evaporated to a small volume and precipitated with alcohol. The precipitate was collected on a weighed ashless filter, washed with alcohol, dried, weighed and incinerated, and the loss of weight occasioned by the combustion of organic matter was recorded as dextrin, after I had convinced myself that it really was dextrin by the red coloration which the solution of such a precipitate assumed after addition of a drop of iodine solution.

A second portion of the residue was hydrolysed with hydrochloric acid under pressure, and the amount of glucose thus obtained calculated as starch. Finally, I determined the nitrogen in the pulp and calculated from this figure the percentage of albuminoids by multiplication with the factor 6·25.

The figures for the different analyses are as follows :—

Date of the Analysis	17th April.	19th April.	20th April.	22nd April.	23rd April.	24th April.
Degree of Maturity	Unripe. The skin adheres to the fruit.	Unripe. The skin detaches easily.	Begins to ripen.	Almost ripe.	Ripe.	Over-ripe.
Per cent. peel	45	44	43	39	37·8	36·2
Per cent. fleshy matter ..	55	56	57	61	62·2	63·8
Composition of the pulp :—						
Moisture	58·24	59·21	59·48	59·86	60·88	61·12
Dry substance	41·76	40·79	40·52	40·14	39·02	38·88
Insoluble in alcohol ..	39·41	34·06	29·58	20·98	15·30	13·00
Soluble in alcohol	2·35	6·73	10·94	19·16	23·72	25·88
Sucrose	0·86	4·43	6·53	10·50	13·68	10·36
Glucose..	0·25	0·96	1·80	3·18	4·72	6·1
Fructose		0·90	1·53	2·70	3·61	4·8
Dextrin	trace	0·52	0·59	0·69	0·65	0·65
Starch	30·98	24·98	20·52	13·89	9·59	7·68
Albuminoids	2·65	2·60	2·60	2·58	2·58	2·55
Ash	0·94	0·96	0·97	0·95	1·00	1·01

The skin contains rubber, fibre, and also a small amount of soluble carbohydrate, and its composition calculated on 100 parts of dry substance does not vary considerably in the green and in the ripe state. The water content, however, diminished greatly during ripening, so that the shrinkage of the skin was chiefly due to loss of water. The analysis of the pulp shows large differences during the after-ripening because of the starch being rather suddenly transformed on a large scale into sucrose. That the sugar present in the ripe fruit was really sucrose was proved by evaporating the clarified alcoholic extract from ripe bananas, and allowing it to crystallize. After some time it deposited crystals which were recognised to be sucrose by numerous chemical and physical tests. In the ripe fruits this sucrose becomes partly inverted or consumed by the aspiration either as such or as products of its inversion. The latter possibility is the more probable one, as first of all much carbonic acid is formed during the after-ripening, and secondly because the fructose is in every case present in a smaller proportion than the glucose. It is evident, therefore, that these two constituents are not consumed together as sucrose, but separately after the splitting up of that body, and then the fructose more readily so than the glucose.

During the saccharification process a little dextrin is also formed.

(*b*) *Mango* (*Mangifera*).

The mango fruit, as a rule, is picked when still unripe; in that state the fruits are internally white, hard, acid and flavourless, but within a few days they undergo an after-ripening process which renders them tender, full-flavoured, and yellow or orange-coloured. This period is, as in the former case, soon followed by over-ripeness and decay.

A few mango fruits, of a variety which bears very sweet and well-flavoured fruits when ripe, were cut green, placed in a cool spot at a temperature of 28° C., and weighed every day with this result:—

No.	28th September. gr.	1st October. gr.	2nd October. gr.	4th October. gr.
I.	247	243	241	240
II.	229	226	224	223
III.	227	223	222	219·5
IV.	249	247	246	244

Five mangoes were weighed and placed under a glass bell jar through which a current of air free from carbonic acid was conducted, which afterwards was made to pass through a Liebig potash bulb. This latter was weighed daily, as were the five samples at the end of the experiment.

	Grammes.
The fruits weighed originally	1139·3
After three days	1121·3
Therefore lost in three days	18·0
The potash bulb increased during:—	
The first day by	1·712
The second day by	1·276
The third day by	1·570
Or, in three days	4·558

or, 0·40%, so that the fruits had given off 0·40% of carbonic acid in three days.

Just as in the case of bananas, a mango fruit from a parcel having practically the same initial maturity was daily analysed; and this time the analysis extended to a determination of free and total citric acid. I have previously stated that the acid in mangoes was really citric acid and that no other organic acid could be found in them. I determined the free citric acid by titration with N/10 potash in the boiled fruit, whilst the amount of total citric acid was ascertained by extracting the boiled fruit with alcohol and precipitating the citric acid in the alcoholic liquid by means of barium acetate. This precipitate was filtered off, washed, incinerated, and finally, I determined the carbonic acid in the ash, reckoning it as equivalent to the total citric acid in the precipitate.

Date of the analysis....	29th September.		1st October.		2nd October.		4th October.
Degree of maturity ..	Unripe.		Almost ripe.		Ripe.		Over ripe.
Moisture	83·34	....	82·95	....	81·95	....	83·20
Dry substance	16·66	....	17·05	....	18·05	....	16·80
Soluble in alcohol	6·36	....	15·18	....	15·54	....	14·70
Insoluble in alcohol	10·30	....	1·87	....	2·51	....	2·10
Sucrose	2·57	....	10·50	....	12·27	....	9·31
Glucose	0·60	....	1·53	....	1·30	....	2·10
Fructose	1·90	....	2·10	....	2·01	....	2·60
Starch	8·53	....	0·55	....	—	....	—
Free citric acid	1·36	....	0·34	....	0·25	....	0·10
Total citric acid	1·31	....	0·37	....	0·21	....	0·10
Ash	0·42	....	0·44	....	0·41	....	0·43
Albuminoids..	0·80	....	0·80	....	0·75	....	0·73

The yellow colouring matter, which is produced during the ripening process, shows the same chemical reactions as the carotine from carrots, the same spectroscopic appearance, and in fact resembles it in every respect.

During the after-ripening the starch is transformed into sucrose, which later on becomes hydrolysed and split up into glucose and fructose. In the beginning of the process the fruit liberates water, but this constituent increases later on owing to the combustion of the carbohydrates. The citric acid is vigorously attacked and the decrease in the acid taste during the after-ripening is not due to an increase in the sugar content, nor to a neutralization of the acid, but solely to combustion and therefore destruction of the citric acid itself.

(c) *Tamarind* (*Tamarindus*).

The tamarind fruits remain on the tree until they are fully ripe and thus do not undergo any after-ripening process after being plucked or shaken off. In an unripe state the flesh is white and hard and fills the whole pod, so that the woody skin is firmly attached to it. Later on, when the fruit ripens, the flesh becomes tender and brown and, owing to evaporation, shrinks in such a way that a large empty space exists between the dry pulp and the hard skin.

The composition of the pulp of tamarind fruits in several stages of ripeness is given here :—

Date of the analysis ..	11th May.		27th May.		20th June.		15th July.
Degree of maturity ..	Green.		Almost ripe.		Ripe.		Dessicated.
Dry substance	15·86	....	38·46	....	40·92	....	76·20
Moisture	84·14	....	61·54	....	59·08	....	33·80
Glucose	0·40	....	10·10	....	20·4	....	25·10
Fructose	0·33	....	5·10	....	11·6	....	10·6
Fibre and pectin	3·27	....	8·10	....	7·90	....	14·57
Starch	3·33	....	1·25	....	—	....	—
Free tartaric acid	3·25	....	15·8	....	14·6	....	—
Total tartaric acid	4·85	....	18·1	....	16·4	....	14·4
Potassium bitartrate ..	4·00	....	5·76	....	4·50	....	—

In this case too the starch has become transformed into sugar during the ripening but this time not into sucrose, but into a mixture of glucose and fructose. At the same time a large amount of water was *evaporated causing the fruit to shrink considerably in its envelope* and finally much acid was consumed by respiration, since the amount of total tartaric acid in the dessicated fruit was smaller than that in the much more juicy one of a month before. The increase of the percentage of sugar after the period of maturity is due to the strong concentration by evaporation, because no fresh formation of sugar can possibly have taken place in so dry a fruit.

(*d*) *Sapodilla* (*Achras sapota*).

These fruits are plucked tree-ripe, in which state they are green and hard and contain gutta-percha and tannin dissolved in the sap, which render the fruit unfit for eating. After they have been preserved in bran, the gutta-percha as well as the tannin become insoluble, and the fruit gets tender, full-flavoured and palatable. On examining sections of the fruit one sees the coagulated gutta-percha as a series of white threads, while the tannin is deposited as insoluble matter in certain cells.

The analysis of such fruits in a tree-ripe and full ripe condition are given here:—

Constituents.	Tree Ripe.	Full Ripe.
Moisture	74·76	75·20
Dry substance	25·24	24·80
Sucrose	7·80	7·02
Glucose	2·85	3·7
Fructose	2·70	3·4
Starch	Absent	Absent
Pectin	3·34	4·00
Albuminoids	0·45	0·40
Ash	1·50	1·50

Unlike the after-ripening of the other three fruits, this one is not due to the saccharification of starch. The amount of sugar before and after the full ripening is the same, but in this case the fruit has become palatable by the softening of the hard pectin and by the deposit of the tannin and gutta-percha in an insoluble form.

I have to mention here that I did not find lactose in this fruit, which has been stated by Bouchardat as being one of its constituents. They, however, contain much pectin, and owing to the presence of that body the juice yielded a fair amount of mucic acid on oxidation with nitric acid; this renders the supposition probable that this acid considered by Bouchardat as an evidence of the presence of lactose, had simply come from the pectin.

II. Agents of the Saccharification during After-ripening.

When studying the fruits which come first into account in the research under consideration, viz.:—the banana and the mango fruit, we found in a certain stage of the development a rather sudden transformation of starch into sucrose, followed in a later stage by inversion and partial degradation of the products of inversion.

From experiments on the determination of the carbonic acid in the atmosphere, in which this sudden transformation took place, I came to the conclusion that the period of the rapid saccharification just coincided with a strong development of carbonic acid, or with a powerful oxidation and respiration. At the same time the moisture on the inside of the glass bell jar in which the fruits ripened showed that a copious evaporation had accompanied the oxidation.

The figures for the carbonic acid from the bananas showed on the second day a strong development which decreased very soon, whilst those for the mangoes remained somewhat stationary for the three days under observation. These data corresponded very well with the more rapid after-ripening of the former fruits during this experiment in which they had turned from green into yellow even on the second day.

The transformation is therefore accompanied by oxidation and I tried to check it by excluding the fruits from the free access of oxygen. To this end I covered a few green mango and banana fruits with collodion and kept them together with a few similar fruits not covered with an impermeable layer. The covered fruits did not ripen well and were converted into decayed masses, while locally the wrinkles occasioned by the dying off of the fruit caused the collodion layer to burst and thus made the experiment unreliable. Moreover it might well be that the decay was not only a consequence of the exclusion of oxygen but also of the hindered evaporation, which would be injurious to the fruit. In order to elucidate this point, a few bananas were placed in a tube through which a current of nitrogen passed, while at the same time some other bananas from the same part of the bunch were kept in the ordinary atmosphere as a check. When the latter had become tender, yellow, and ripe, those in the nitrogen tube had still retained their green and hard appearance. The analyses of the peeled fruits yielded these figures:—

	In Nitrogen.		In Air.
Moisture	70·54	....	68·36
Insoluble in alcohol	25·90	....	11·06
Soluble in alcohol	3·57	....	20·58
Sucrose	0·31	....	13·66
Reducing sugars	0·94	....	4·80

It followed then that the after-ripening in the air had gone on uninterruptedly whilst the fruits kept in the nitrogen atmosphere had

remained unchanged and had preserved their starch content; so that it is evident that free access of oxygen is an indispensable condition for the saccharification of starch in the fruit.

The following experiments were undertaken with a view to ascertaining whether the saccharification was brought about by a vital process or by the action of some diastatic ferment present in the fruit.

A hot jelly consisting of isinglass and agar-agar, of such a composition that it was solid at the ordinary temperature, was mixed with 1% of starch, poured into a series of Petri dishes and sterilized. Slices of green mango and banana fruit, or pieces of half-ripe tamarind were placed on the stiff jelly in some dishes, and on that of others figures and letters were traced with a pencil dipped in mango juice. After two, or sometimes more, days the particles of fruit were removed and the jelly covered with a dilute solution of iodine in potassium iodide, which after having remained there for a minute was washed off. In every case not only the spot where the fruit had been placed or where the pencil strokes had been applied, remained white, but all around a white stain spread out, lined with a red border which gradually faded into the surrounding blue coloration of the still unattacked starch. The longer the dishes had been allowed to stand, the larger was the white stain. In every one of these cases, therefore, a diastatic ferment had diffused from the fruits and from the juice, which had transformed all the starch it could get hold of through the stage of dextrin into sugar. When the iodine solution was allowed to act too long on the jelly, the iodine penetrated through the surface layer and reached the lower one, where the starch was still unattacked, thus colouring the whole dish blue. Finally, pieces of banana and tamarind fruit were placed on slices of sterilized potato; the result was the saccharification of the starch caused more or less deep cavities to appear in the places where the fruit had been applied.

All this however is not yet a direct proof that the saccharification has been occasioned by a ferment; and in order to make this clear I immersed slices of banana into alcohol, left them there during a couple of days, then took them out, expelled the alcohol by means of sterilized air and placed them again in Petri dishes on a layer of starch emulsion stiffened with isinglass and agar-agar. Though not so rapid as in the case of the much more juicy fresh fruit, yet here also the ferment diffused through and after the application of the iodine solution, the white stains with the red linings became visible.

A quantity of mango juice was added to a boiled and re-cooled solution of 3% starch at 50° C. and kept at that temperature for some time. The liquid, which, at the outset, had given a deep blue reaction with iodine solution, only became red when at the end of the experiment this test was repeated; this coloration did not undergo any change even if the mixture was kept for some time

longer or if a fresh quantity of mango juice was added. The total amount of sugar contained in the liquid (for the mango juice itself had also contained sugar) was higher after the reaction than before, which showed that the mango juice had contained a *diastatic* body with power to transform starch into dextrin and into sugar.

Now the question still remained, which sugar was formed in the laboratory outside of the living organism.

The ripening fruit and their juices already contain so much sugar which mixes with the small amount of sugar formed by the saccharification of the starch that the proper indentification of that latter portion is extremely difficult if not impossible.

In order to eliminate the influence of the already existing sugar, ripening banana fruits were peeled and repeatedly triturated with alcohol and the extracted pulp which contained as little sugar as possible was pressed, powdered, and dissolved in glycerin. After a few days the amount of sugar and its nature was ascertained in the glycerin by polarimetric and copper tests before and after inversion. Next 100 grammes of this glycerin were mixed with a 3% starch solution, warmed to 40° C. and kept at that temperature for a couple of hours. After that the dissolved starch and dextrin was precipitated with alcohol, filtered, a pinch of calcium carbonate added to the filtrate to prevent inversion by the slightly acid reaction of the filtrate, and the alcohol evaporated off. The syrupy residue was dissolved in water, filled to the volume of 100 c.cm., and used for the determination of the sugars by the polarimeter and Fehling's solution before and after inversion.

The original glycerin solution had contained 0·17% of glucose both before and after inversion, while after the treatment with starch, 100 grammes of the solution contained 0·60 grammes of reducing sugars before inversion and 0·67 after that operation, which showed that 0·43 grammes of glucose and 0·07 grammes of sucrose (?) have been formed from the starch by the ferment. The polarization of the solution was + 0·9 before and + 0·4 after inversion, giving evidence that, notwithstanding the precipitation with alcohol, a small amount of starch or dextrin had still remained in the filtrate.

At any rate from the fact that the exclusion of oxygen prevents the saccharification of the starch in the fruit and from the negative results of the experiments on formation of sucrose by means of fresh juice, and of the precipitated and re-dissolved ferments, it follows that the rapid transformation of starch into sucrose during the after-ripening of some fruits is a vital process and not a consequence of the action of some ferment contained in the fruit which, just as diastase is able to form maltose from starch, could be isolated to form large quantities of sucrose from any kind of starch in the laboratory.

INFLUENCE OF STRIPPING OFF BEET LEAVES ON THE PLANT.

We have recently referred to the experiments undertaken in the Hawaiian Islands to establish the effects of the stripping of cane leaves during growth. The result, it will be remembered, was entirely unfavourable to the practice. Similar experiments have recently been carried out on sugar beet plants by V. Andrlick and J. Urban, and these investigators likewise came to the conclusion that stripping injures the crop. Their conclusions as given by the *American Sugar Industry* from a Continental sugar exchange are as follows:—

"1st. An extensive and premature stripping of leaves (70%) at the beginning of July had the effect of diminishing the crop about 36 per cent. The sugar was diminished 35 per cent., and the dry matter 34 per cent. The saccharine richness of the roots was only 0·25 per cent. inferior to that of roots where the leaves were left intact. The stripped plants took from the soil the full amount of the crop less the fertilizing substance: 38 per cent. nitrogen, 34·9 per cent. potash, and 36 per cent. phosphoric acid. The stripped plants remained inferior to the entire plants both in the production of dry matter and in the absorption of fertilizing elements. The practice of stripping is therefore quite useless. But the quality of the roots was not notably worse.

"2nd. A complete stripping at the end of July gave a yield in roots smaller by 24 per cent.; in leaves by 23 per cent., and in sugar by 30·5 per cent. The saccharine richness of the sugar beets was 1·1 per cent. inferior to that of beets that were left intact. There was less fertilizing substance in the stripped beets than in the entire plants, amounting in nitrogen to 30 per cent., potash to 28 per cent., and phosphoric acid 18 per cent. A complete stripping is injurious both to the grower and to the sugar manufacturer.

"3rd. A late stripping (August 19) of 19 per cent. gave a product 13 per cent. inferior in roots and 3 per cent. greater in leaves. The saccharine richness was not modified. The sugar crop was 13 per cent. smaller. The quality of the roots was better than before for the sugar manufacturer.

"One may conclude with the authors that a stripping of from 50 per cent. to 94 per cent. injures the grower, by diminishing his crop from 10 per cent. to 26 per cent., and the manufacturer, by reducing the saccharine richness from 0·5 per cent. to 2·7 per cent.

"A moderate stripping produces a diminution of yield in roots of 1 per cent. to 14 per cent., while the richness in sugar is not modified. This establishes the uselessness of the practice even when the sugar beet possesses a very abundant foliage."

ROOT DISEASE OF SUGAR CANE IN LOUISIANA.*

By H. R. Fulton.

Historical.

The root disease of sugar cane was first described from Java in 1895 by Dr. J. H. Wakker, who gave it the name "Dongellanziekten," the disease of the underground part of the cane stalk. He observed the disease on the sprouting cuttings of the "nurseries" and the older canes of the fields; and he found the causative organism to be a fungus which he described and proposed as a new species, *Marasmius sacchari*. This fungus, primarily a saprophyte, has acquired the habits of a wound parasite, and finds in connection with cane cuttings and cane plants conditions most favourable for its full development and fruiting.

At about the same time studies upon a similar disease were begun in the British West Indies, and were carried on for a number of years by several investigators. An extensive account of the disease, however, was not published until 1903, when Mr. A. Howard gave the results of his studies in Barbados.† He attributes the disease to Wakker's species of *Marasmius*, and adds materially to the knowledge of the conditions favouring the attacks of the fungus upon the cane plant. Further observations made by Mr. F. A. Stockdale lead to the opinion that probably more than one species of *Marasmius* attack sugar cane in the West Indies.

In 1905 Mr. L. Lewton-Brain published a preliminary account of the disease in the Hawaiian Islands, and in 1906 there followed a very complete account by Dr. N. A. Cobb.‡ According to these writers a certain amount of the root disease occurring in the Hawaiian Islands is caused by a species of *Marasmius* which differs in minor characters from Wakker's species, and is accordingly proposed as a new variety, *Marasmius sacchari* variety *hawaiiensis*. Dr. Cobb also attributes a considerable amount of the root disease in the Hawaiian Islands to a fungus of a very different type, *Ithyphallus coralloides*, a member of the so-called stink-horn group of fungi. He expresses the belief that further study will show that still other fungi, having the same general mode of living, play a part in causing root disease.

Appearances Indicative of Root Disease.

Affected stools show very constantly and markedly root systems that are deficient in their development, and that show a considerable percentage of dead roots. Such stools have a weak hold on the ground and may be pulled up with comparative ease; they are also the ones most generally prostrated by storms. The canes of these

* Abridged from Bulletin No. 100 (Illustrated) of the Agricultural Experiment Station of the Louisiana State University.

† See *I. S. J.*, June, 1903. ‡ *Ibid*, April, 1907.

stools are reduced appreciably in size and weight. The leaf system is reduced; and when the supply of available moisture in the soil falls below normal, symptoms of water starvation are apparent, while other stools maintain a normal appearance. When the drought conditions become more severe, a large percentage of affected stools die. These effects are caused by the deficiency in root system. They are more pronounced in stubble than in plant cane, for reasons that will be indicated later. The lower leaf sheaths (shuck) of affected canes do not fall away, leaving the older part of the canes clean, as is normally the case, but they adhere closely for some distance, as much as eighteen inches, from the surface of the ground, and can be removed only with difficulty. They are seen to be cemented together by the whitish mycelium of a fungus which has a characteristic mouldy odour. Under favourable conditions, which seem to occur with comparative infrequency, the toadstool fructifications of the fungus are to be found in connection with the mycelium.

This fungus which cements the leaves is the organism that causes the destruction of the cane roots, from which result the acute symptoms of disease and the ultimate reduction in the yield. The fungus is primarily a soil-inhabiting organism, and its appearance above ground on the somewhat moist and nutritious leaf sheaths where conditions are favourable for its growth, is rather incidental. The fungus may infest a stool of cane, especially in the plant crop, and cement the sheaths in the characteristic way, and yet not affect the roots or injure the stool appreciably in any way. Such a stool can not strictly be regarded as diseased; and yet with the fungus present it is probable that sooner or later the living tissues will be permeated, and typical root disease induced. On the other hand, even in stools that suffer most from root disease, it is usual to find a certain percentage of the individual canes without indications of the fungus above ground. But with all of this, the matting of the leaf sheaths is a most useful indication of the actual or potential presence of root disease. This matting is not very conspicuous until about the time the cane "begins to joint," about August.

The Cause of Root Disease.

In Louisiana a species of fungus which is regarded as being in all probability *Marasmius plicatus*, Wakker, is found constantly associated with growing cane or with decaying cane parts. The canes on which it occurs show generally, though not invariably, a dwarfed growth, a reduced root system, and, during a period of drought, are the ones to succumb most readily; canes without the fungus have nowhere been observed to show generally these symptoms. Mycelium of the fungus has been observed in living and dead roots. Repeated inoculations with pure cultures have produced in living young cane plants the characteristic symptoms of root disease. The

fungus has been recovered in pure culture from such artificially infected plants.

These facts lead to the conclusion that the species of *Marasmius* found generally on sugar cane in Louisiana, which is regarded as *Marasmius plicatus*, Wakker, must be added to the list of fungi that have the ability to induce the so-called root disease of sugar cane.

Specimens of Louisiana cane showing the characteristic mycelial growth, but not the fructifications, have been submitted to the proper authorities at the experiment stations in Java, Hawaii, and Barbados. In all cases the reports have been that in so far as could be judged from the material, the appearances were those of root disease.

With regard to two pieces of fungi belonging to the stink-horn group, and found in some numbers in the cane fields of the State, definite statements cannot be made at present.

The Fungus.

Marasmius plicatus belongs to the toadstool or mushroom group of fungi. In common with other members of the group, the organism has a vegetative part known as the mycelium, made up of minute branching white threads which ramify through the nutrient substratum. It is this mycelium that is found infesting the dead roots and the matted leaf sheaths of the cane plant. When conditions of moisture and food supply are favourable there develop in connection with the mycelium the fructifications of the fungus. They appear at first as small, ball-like masses of mycelium; these increase in size, and gradually become differentiated into the component parts of the fully developed fruit body. These fructifications are seldom observed since they are formed with comparative rarity, and since they remain fresh for a very short time.

The fruit body has the characteristic toadstool form, with an upper expanded portion, the cap or pileus, and a supporting stalk, the stipe. The pileus is dirty white, becoming somewhat darker with age; it is usually about three-fourths of an inch in diameter, but may attain a size of an inch and one-fourth. When young it is convex, and at maturity is almost flat or perhaps slightly concave. Its surface is smooth. On the under side are the radiating gills which have an even, thin edge, and a straight, radial direction. The long gills extend from the margin to the stem, and are attached to the stalk itself rather than to a prominent ring about the stalk. Other shorter gills extend from the margin just far enough to fill in the angles between the longer gills. The stipe is about equal in length to the diameter of the cap, or in some cases, somewhat less. It usually arises from the side of the leaf sheath, and is somewhat curved so as

to bring the cap into a horizontal position. It is normally attached to the cap at its central point, but at times this attachment is somewhat eccentric. The stipe is smooth externally, except at the base, which is downy and also enlarged. The whole fruit cap persists for about a day, and then gradually dries, losing its form, but not undergoing immediate disintegration. When moistened it regains something of its original form. The gills produce upon their surface the spores of the fungus, which are minute oval bodies of microscopic size. They show a pure white colour in mass. Their function is to reproduce the fungus plant. This they do, under suitable conditions, by sending out a small thread which may by its continued growth develop into the mycelium of a new generation of fungus.

This fungus grows saprophytically upon decaying vegetable matter, seemingly showing a rather strict selective preference for parts of cane plants. In the laboratory it grows well upon a wide range of nutrient media. In addition to this saprophytic mode of living the fungus has the ability to attack living tissues, probably only when their vigour is impaired, and thus to adopt the mode of life of a parasite. It is in this rôle that the fungus becomes of economic importance in causing damage to cane plants.

Modes of Distribution.

The spores of fungi are the parts specially formed and adapted for the reproduction and dissemination of the parent organism. Spores are produced in very large numbers on the under side of the fruit caps of *Marasmius plicatus*, and they germinate with comparatively little difficulty. But the fruit caps are produced only under exceptionally favourable conditions, and there is no evidence of any increase of the fungus following the production of the spores in a given locality. In the mushroom group as a whole reproduction by spores seems to be of relatively little importance. On the whole, it seems probable that spores have a comparatively unimportant part to play in the propagation of the sugar cane *Marasmius*.

To a much greater extent than among higher plants, detached portions of the vegetative part of fungi can reproduce the plant. Bits of the mycelium of the root fungus of sugar cane grow and spread rapidly under favourable conditions. A small amount on the butt of a planted stalk may be the means of infecting one or more stools of the plant cane to which it gives rise. It is thus by the planting of infected stalks that the root fungus is most efficiently spread from field to field, and continued from year to year.

During the season of 1907 three field tests on two plantations in West Baton Rouge Parish were made to determine what part the planting of affected canes plays in the continuance and spread of the fungus. The results were as follows :—

Experiment.	Rows.	Seed Cane.	Percentage Affected Stools.	Percentage Affected Stalks.
A	1	Affected whole stalks	73	30
A	2	Sound whole stalks	23	17
B	1-3	Affected whole stalks	85	63
B	4-6	Sound whole stalks	63	35
C	1-4	Affected whole stalks	89	61
C	5	Affected lower halves	100	91
C	6-10	Sound whole stalks	1·7	0·7

It is noticeable that the amount of fungus was constantly greater when affected stalks were used for planting, and was greatest for the row planted with the lower halves only, that is, with the part having the fungus most abundant. At the outset nothing was known regarding the amount of the fungus that might be present in the soil. In experiments A and B it was later very evident from the showing of the control rows and of the fields in question generally, that the soil was everywhere thoroughly infested with the fungus. This accounts for the rather high percentages for the rows planted with sound cane in these two tests. In experiment C there was very little evidence of the presence of the root fungus in any part of the field, and the control rows remained almost free from it. The cane used for the general planting in all three fields was from the plant crop and showed an unusually small percentage of stalks with adhering shuck.

A third means of distribution is by the persistence of the mycelium of the fungus in the decaying roots and other cane trash of the fields. A certain amount of such infected material must of necessity remain over from one season to the next and can become the source of infection for the new crop of cane. The root fungus similarly protected can withstand lower winter temperatures than can the cane. Young cultures were killed by an exposure of six hours to temperature ranging from 3° to 14° F., but survived an exposure of 45 minutes to the same range. Exposure to 32° F. for six hours was not fatal. Growth took place slowly during a prolonged exposure to 50° F., and most rapidly at about 85° F. Young cultures survived exposure of 45 minutes to 122° F., but were killed by exposure to the same temperature for one and one-quarter hours.

Further data are necessary before statements can be made regarding the period of persistence of the fungus in the soil when not planted in cane.

Occurrence in Louisiana.

This root disease has existed for a long time in Louisiana and is now distributed pretty evenly through all the cane-growing districts of that State. At least six instances of fructifications that rendered identity certain have been collected, and numerous canes with matted leaf sheafs of characteristic appearance have been noted in many parishes. The percentage of infestation varies from 5 to 8 % in ordinary cases to 90 or 95 % in some of the worst fields. But even

these figures by no means represent the total loss as there is an invariable reduction in the number of canes per stool. It has been found that D 74 and D 95 are less infected than Purple and Striped.

Conditions favouring Attack.

When all conditions are conducive to vigorous thrifty growth of the cane, the fungus, though present about the stool, has little or no effect on it. But anything that disturbs such an optimum condition of the cane, and weakens it, may be the occasion of successful attacks by the fungus and greater destructiveness in consequence. Some of the more important of the conditions that tend to lessen the vigour of the cane, and thus render it liable to attacks of the disease are the following:—

1. *Slowness of germination and early growth.*—This is shown by the fact that fall plant cane and ratoon cane, which continue long under ground ere active growth commences, have a larger percentage of infection than spring plant cane.

2. *Improper cultural procedures.*—The point to be emphasized here is that an unhealthy weakened condition of the cane when due to poor or inadequate cultivation is in itself a predisposing factor for the destructive attacks of the root fungus.

3. *Unsuitable soil.*—A too thin soil produces under-developed and struggling cane plants which fall an easy prey to the root fungus.

4. *Bad drainage.*—It is commonly the case that heavy, poorly drained soils show a very large proportion of the canes infected with root fungus.

5. *Unfavourable season conditions.*—Drought produces the worst effects of the root disease, due to the rapid and pronounced deterioration of stools already infected, especially in the case of ratoon crops. The stunting and dying of the stools in periods of drought follow directly from the insufficiency of their root systems.

6. *The ratoon crop.*—It is chiefly in the ratoon crop that the root disease makes headway. The interval between the taking off of the plant crop and the sprouting of the ratoons favours the establishment of the fungus in the trash and decaying parts about the stumps.

Preventive Measures.

Methods for the control of the root disease are at once suggested by an understanding of the modes of invasion and dissemination of the fungus, its causative agent. In a word, such procedures must follow the lines of proper cultivation and the use of sound seed cane. Preventive measures must be relied on, not remedial ones. Amongst them are:—

1. *Careful cultivation.*—This implies proper tillage, active and thorough cultivation, especially of the ratoon crops, good drainage, and rotation of crops.

2. *Selection and disinfection of seed cane.*—As the planting of infected canes not only introduces the fungus throughout the field, but does it in such a way that the plant stools become readily infected, it is important to avoid such a contretemps. Sound cane only should be planted. Non-infected seed can be secured in two ways: (1) By careful inspection of cane for planting with the rejection of all suspected ones. (2) By thorough disinfection with some good fungicide, such as Bordeaux mixture. Of these two methods the former is less expensive, but probably also less effective, since there is always a chance that some slightly infected stalks will be overlooked. But both methods are tedious and costly when carried out on a plantation scale. By setting apart a tract of superior land that is free from root fungus infestation for growing seed cane, and by careful selection and perhaps disinfection of the seed, cane for the general planting can be obtained at a minimum of expense.

2. *Resistant varieties.*—Certain varieties have greater freedom from root disease than others.

4. *Destruction of infected trash.*—The mycelium of the fungus lives over from season to season in the dead and decaying parts of affected canes left over in the fields. Burning over the fields destroys most of this, and in addition the removal as thoroughly as possible of old cane stumps previous to the new crop serves the same object.

5. *Resting land from cane.*—Where the foregoing measures prove inadequate to properly control the disease, the plan of keeping the cane off the land for several seasons will meet with more success. Unfortunately data are too incomplete for anything to be said about the length of time necessary for the complete eradication by this method of the fungus from a badly infested field. Frequent ploughing so as to expose the soil thoroughly to the sun and dry it would help much. The ratoon crops are not the only ones in which the greatest losses occur, but they are the ones that best serves as nurseries for the fungus. When a plant crop is so badly affected by the root disease as to make the margin of profit dangerously small, it should be borne in mind that the ratoon crop will show even worse effects of the disease.

It may be added that it is now difficult to find specimens of the root fungus in Java. The system practised there of quick rotation with the elimination of ratoon crops, and the great care taken with the planting material have no doubt played an important part in bringing about the results.

The work in the Hawaiian Islands has been too recently undertaken for definite results. Published accounts of late date from the British West Indies indicate that careful cultivation, rotation of crops, selection of sound seed cane, and the choice of disease-resistant varieties are measures that are being used there with an encouraging degree of success.

THE SUGAR INDUSTRY IN EGYPT.

As is generally known, the sugar industry in Egypt is mainly in the hands of the Société Générale des Sucreries et de la Raffinerie d'Egypte; this Company has been passing through a time of great financial difficulty, but is now, it is hoped, well on the way to recovery.

During 1906-07 this Company dealt in its usines with 414,877 tons of canes, having a sugar content of 12·70%, as compared with 684,608 tons, of 12·34% sugar content during 1905-06. The amount of canes obtained in 1906-07 was considerably less than in the preceding year owing in the main to the high prices offered to the planters by the dealers.

The quantities of cane worked up were divided amongst the five working factories as follows:—

	Tons.	Yield per cent.
Mattai	40,671	12·75
Aboukourgas	73,590	12·91
Nag-Hamadi	147,520	12·49
Cheikh-Fadl	97,180	12·66
Ermant	55,905	13·18

The yields in sugar per weight of cane have been as follows:—

	Yield in Sugar per cent. Cane. 1st Jet.	2nd Jet.	Total.
Mattai	9·56	0·75	10·31
Aboukourgas	10·37	0·21	10·58
Nag-Hamadi	9·86	..	9·86
Cheikh-Fadl	10·22	..	10·22
Ermant	10·03	0·95	10·98
Mean	10·03	0·13	10·16
Mean 1905-06	9·13	0·30	9·43

In 1906-07 the mean polarization was 99·08 as compared with 99% in 1905-06, being a proof of the high quality of the finished product. The production comprised 416,640 sacks of first jet sugar and 5308 sacks of seconds. Of the former, 191,243 sacks went into direct consumption and 225,973 sacks were destined for the refinery.

The mean yield in sugar of 10·16% on the weight of cane in 1906-07 is considered a satisfactory one, having given a sugar of high titrage, thanks to the greater richness of the canes, the improvements in the extraction and the exhaustion of the raw material. The main object the management has had in view has been to reduce the losses during extraction to a minimum and to avoid as much as possible a high proportion of low products. At Nag-Hamadi and Cheik-Fadl, only first jet sugar is produced.

As regards molasses, the five usines obtained in the campaign under review 38,330 kg. as compared with 39,380 kg. in the previous year. The cost of production of each usine is shown in the appended table:—

	1st Jet Sugars. Sacks of 100 kgs.		Net cost in frs. per sack of 100 kgs.
Cheikh-Fadl	99,335	....	24·81
Nag-Hamadi	145,972	....	28·42
Mattai	38,909	....	28·42
Aboukourgas	76,331	....	23·62
Ermant	56,093	....	24·47
Total	416,640	Mean ..	26·14

Thus the average net price in 1906-07 was 26·14 frs., whilst in 1906-06 it was 25·92 frs. But it has to be observed that the price of 1906-07 includes commissions and rent which were not previously included, so that the average net price of this last campaign is lower than that of the preceding one. Except in the case of Mattai, which only worked up a third of its supply in 1905-06 and of Nag-Hamadi, which suffered from unforeseen adverse circumstances, the usines have appreciably decreased their working expenses.

In this connection the Governing Board made the following statement in their annual report:—

"It must not be overlooked that our usines have to bear a fixed expenditure, the more onerous in that it is based on low quantities; and the fact that we have not exceeded the mean cost of production, in spite of the large deficit in supplies of 269,731 tons as compared with 1905-06, bears witness to the real progress in our enterprise. It shows that we can still further lower the net price if our usines were kept better supplied. All our usines have been working under unfavourable conditions, their supplies of cane being only about 50% of their full capacity in a normal campaign. In consequence, all our efforts will be directed towards procuring as large a supply of cane as possible, and the sacrifices we put up with to obtain this object will be fully compensated in the reduction in our manufacturing expenses. The meagre supplies accorded to Mattai has decided us to close this usine provisionally; it will therefore not work in 1907-08."

So as to facilitate the supply of canes to the usines the Company has extended the system of advances to cultivators; therefore an appreciable increase in the cultivation is being hoped for in 1908-09. Experiments in the propagation of tropical canes have been undertaken and have given yields exceeding by 25 to 30% those of the native canes. Certain varieties mostly imported from Java have been reproduced already and are renowned amongst the cultivators. Undoubtedly the price obtained for cotton militates seriously against the extension of the cane sugar industry in Middle Egypt, but it is

supposed that with a better yield the cane will once secure the commanding position which it once held. For 1907-08 the predictions made at the end of last year forecasted about 375,000 tons of canes, but a greatly increased output is expected in 1908-9.

Everything in short points to the belief that the present moment marks the transition period between the financial crisis in which the Company was involved and the re-establishment on a firm basis of an industry which is intimately connected with the prosperity of Upper Egypt.

The Hawamdieh refinery, which belongs to the same Company, had the following figures of output for 1906-07 :—Sugar melted, 336,701 sacks, equal to 33,478 metric tons, of which 30,851 tons were supplied by the Company, 1579 tons by Sultan Omar Bey, and 1046 tons came from Java. In 1905-06 the refinery melted 531,500 sacks of raw sugar or 194,799 sacks more than in 1906-07.

The polarization of the raw sugar was 98·55, titrage was 96·30 %, 31,658 tons of refined sugar or 94·21 % of the total meltings were produced; besides which there were 20,789 tons of syrup and 700 tons of molasses or 2·083 % of the raw meltings. The sucrose in the refined products polarized at 97·96 per 100 of raw sugar. The manufacturing losses were lowered to 0·585 % of the polarization.

This refinery is big enough to be able to melt twice as much sugar as was delivered to it last campaign. The cost of refining, packing and transport excluded, has risen to 3·47 frs. per 100 kg. of raw sugar entered and 3·59 frs. per 100 kg. of refined (including syrup) as compared with 2·93 frs. in 1905-06. This is an increase for the past campaign of 0·66 frs. per 100 kg.

As regards the sugar market, if we add to the output of the Société Générale (58,088 tons) the imports of foreign sugar amounting to 23,790 tons (of which 3000 were destined for the Sudan) and allow for the difference in the stocks at end of October, 1906, and October, 1907, viz., 3000 tons, we arrive at a total supply of 84,878 tons; from this must be deducted 1500 tons for the refinery requirements, and 1000 tons which were exported to Djedda. We may therefore take it that the consumption in Egypt and Sudan works out at 82,378 tons for the year 1906-07, of which amount nearly three-quarters are supplied by this Société and slightly over one-quarter by foreign sources. Of the latter, 23,790 tons in amount, Austria-Hungary supplied 75 %, and Russia and Belgium the balance.

The mean price of refined in 1906-07 reached 38·74 frs. per 100 kg. as compared with 27·82 frs. in 1905-06. The relations of the Company with the Sudan are developing; in 1907 5993 tons were shipped to that district viâ Halfa, Suakin and Port Sudan, as compared with 4370 tons in 1906 and 3843 tons in 1905.

The Company also exported 11,737 sacks of refined sugar to Djedda and 5284 sacks of candy to Rheims. The Egyptian refined sugar

candy is much in demand in the manufacture of champagnes, and it is reported that Germany too may fall back on this product for flavouring her wines.

The finances of the Company during 1906-7 worked out as follows:—Receipts, £E658,759·828; expenses, £E571,276·170; gross profits, £E87,483·658; administration charges, interest, &c,, £E57,464·355; net profits, £E30,019·303, or 778,206·17 frs. In fact, during the 1906-07 campaign the Societé has been able to strengthen its financial position very considerably, and with a better supply of canes and a higher price for the sugar, the outlook is a favourable one.

According to the latest forecasts, the total Egyptian sugar crop in 1907-08 will amount to 60,000 tons, as compared with 60,000 tons in 1906-07, and 65,000 in 1905-06. The year 1899-1900 saw the largest crop so far recorded, when 98,000 tons were harvested. As a sugar centre, Egypt has not fulfilled the early promises of brilliant development such as some predicted for her. One is, nevertheless, justified in looking with confidence towards her future.

THE CARBONATATION OF BEETROOT JUICES.*

By Eug. Stuyvaert.

(*Continued from page 356.*)

Reheating of Diffusion Juices.—The reheating of the raw juices preliminary to liming is, as will be shown later, necessary when defecation is made with lime in the form of powder or lump, and is advantageous when the material is applied as milk-of-lime. Generally the juices are reheated alone, sometimes it is with a small quantity of lime, and again, in certain cases, the total quantity of the lime used in defecation is added.

Formerly reheating was accomplished in the carbonatation heating appliances by means of coils or injectors. The majority of factories at the present day are provided with a modern installation of reheaters in which the juices are raised to the desired temperature by utilizing the steam from the evaporating plant. Such installations are divisible into two or more systems: the first utilizing the steam from the last evaporating compartment of the triple effet when it is on its way to the condensers, thus allowing the juices to be raised to 45-50° C. without cost; the second system accomplishes the heating by means of the vapour taken from the first compartment. Often steam from three compartments of a quadruple effet is used: that coming from

* Contribution to the *Manuel de la Fabrication du Sucre de Betteraves*, edited by the Société Technique et Chimique de Sucrerie de Belgique. Translated by special permission.

the last carries the temperature of the juices to 45-50° C., the second is utilized to raise the temperature to about 70° C., whilst the third brings it up to the temperature necessary for defecation.

In a satisfactory reheater it should be possible to raise the temperature rapidly, and all the volume of the juice must be perfectly circulated. If heating is slow and circulation faulty, there is always danger of inversion by the acids of the juice occurring.

Reheaters may be horizontal or vertical, open or closed. Open reheaters have the apparent advantage of being more readily cleaned when in use, but in actual practice this is not easily done. In this type of apparatus the juice is exposed to the air and it is thus liable to become changed; again the circulation is not efficient, and therefore the tubes readily become incrusted, and the heating effect impaired. Various devices have been proposed to overcome these disadvantages, with more or less satisfactory results.

Closed reheaters, on the other hand, are certainly more efficient and economical in their working, and their use is becoming greatly extended in the industry. The circulation is much more rapid, incrustation is very much less, and the transmission of heat is increased. This more efficient circulation of the juices is effected by the arrangement of the tubes in bundles; each reheater contains a more or less great number of these, sometimes as many as twenty, and as a consequence the juice is compelled before leaving the apparatus, to circulate over a considerable heating space. Experience shows that the heating effect is the greater the more rapid the circulation of the juices. In the old reheaters the transmission of heat was only 2-3 calories per minute, per square meter, per degree centigrade of the difference of temperature between the juice and the steam, while it is possible to exceed 16 calories in modern plants which possess a very rapid circulation.

Besides the open reheater and the closed rapid circulation apparatus there is an intermediate type, which some engineers prefer, in which the juice circulates at a moderate velocity; it therefore requires a relatively smaller pressure and is thus less exposed to various dangers during working.

As the reheaters become encrusted at the end of a certain time depending on the nature of the juice operated upon, they must be cleaned, otherwise their heating effect would be considerably decreased. It is very advisable to instal a reserve reheater in the system in such a manner that it can be put out of circuit for the purpose of cleaning or repairing without interrupting the working of the department, and this is done in the most modern reheating installations. Cleaning is done by means of metal brushes, or by scrapers if the deposit is difficult to remove. To assist cleaning, the use of boiling water containing 1 per cent. of soda is found to give very good results.

III. Theory and General Principles of the Calco-Carbonic Process.

(a) *Influence of lime on the constituents of the juice.*

In order to conduct the different operations comprising the calco-carbonic process in a rational manner, it is essential to understand as fully as possible the reactions which are capable of occurring when the juices come in contact with the clarifying agents. The knowledge of the phenomena which take place, together with facts of practical observation, serve to establish the general principles which govern the intelligent control of the clarification process.

Influence of lime on the sugar.—It has been proved that lime has no destructive influence on the sugar of the juice under ordinary conditions of working. Certain observers have, however, observed that a certain loss does occur, but further investigation has shown that this is due to a precipitation of the sugar in the form of calcium saccharate, and that in the subsequent carbonic acid treatment the whole of this combined sugar is completely recovered.

When the quicklime mode of liming is used the conditions are different; considerable heat is involved when lime is hydrated, and it could easily be imagined that the high temperature resulting from the addition of a quantity of quicklime to the raw juice would cause destruction of sugar, especially if the volume of liquid was relatively small and the lime and juice were not agitated together. In practice this is not the case. The lime is added gradually to a large volume of juice which is kept in movement so that there is no dangerous rise in temperature and consequently no destruction of sugar to be feared.

The quantity of lime which dissolves in a saccharine solution is greater than that which is taken up by water under the same conditions of temperature, &c. Thus *e.g.*, at 30° C. 100 parts of water dissolve 0·11 per cent. CaO, as compared with 1·31 parts taken up by a 10 per cent. solution of sucrose at the same temperature. Again the quantity of lime dissolved is dependent upon the length of time it remains in contact with the sugar solution. It is for this reason that the amounts dissolved in practice are not in accordance with the tables of solubilities. The most important factor is the temperature, the lower the temperature the greater the solubility of the lime. The next condition is the time of contact, and this is in direct proportion with the quantity of lime passing into solution.

The following table has been worked out by Herzfeld. It gives the amount of lime taken up by 100 c.c. of a 10 per cent. solution of sucrose when treated with 2 per cent. of slaked lime, at different temperatures, and for different periods of time:—

Time in contact. Minutes.	Temperature. °C.	CaO dissolved. Grms.
5	100	0·15
15	80	0·22
30	70	0·27
50	60	0·40
65	50	0·50
85	40	0·65
90	30	0·76

In practice the amount of lime which dissolves in 100 parts of raw juice during defecation is rarely greater than 0·3-0·4 parts. There are yet other factors which influence the solubility, and the principal of these are the nature of the lime, the sugar content of the juices, and the condition in which the lime is used. With regard to the latter, observation has shown that, all the other conditions being equal, the quantity of lime dissolving in the juices is higher when the quicklime method is used than when milk-of-lime is employed.

When juices saturated with lime are heated, and especially when they are raised to boiling point, a precipitate of calcium sucrate separates out; this dissolves on treating with carbonic acid or on lowering the temperature. This fact nevertheless shows that in order to avoid considerable losses of sugar the juice saturated with lime should never be heated to boiling or sent to the filters at that temperature.

Influence of lime on the non-sugar.—The nature and quantity of non-sugar accompanying the sugar in the diffusion juices differ greatly, the amount varying not only with the quality of the material operated upon, but also according to the efficiency of the work of extraction. The quality of the non-sugar depends more especially on the quality of the beetroot, and from this point of view the beetroot sugar industry during the past 15 years has shown a considerable development, for the root has become richer in sugar and the impurities appreciably reduced. These improvements are shown by larger rendements, and are due principally to better and more scientific methods of seed selection. Thus in the years 1892-1895 the average beetroot sugar content was 12·23 per cent., and the diffusion juices contained 15·9 kilos. of non-sugar to every 100 kilos. of sugar; in 1901-1905 the figures for the sugar in the beet rose to an average of 14·65 per cent., whilst the non-sugar ratio decreased to 12·2, and in the 1906 campaign never exceeded 11·7.

Inorganic non-sugar.—The mineral acids and bases are not only combined amongst themselves, but are also found united to organic substances. The action of the lime on these compounds is very variable. Phosphoric acid, which occurs largely in combination with the albumenoid portion, is decomposed and liberated as tricalcium phosphate during the defecation and is thus directly eliminated from

the juice. Of the other acids, sulphuric acid and silicic acid likewise unite with the lime if they are not already in this condition; but these salts are only partially insoluble in the juice and are therefore not entirely eliminated by this treatment. Hydrochloric and nitric acids form soluble salts, and are found in solution at the end of clarification, but these, it should be pointed out, are generally present only in very small quantity.

Of the bases, the alkalis potash and soda constitute usually more than half of the real inorganic non-sugar matters; they remain in the juice in the free state and eventually combine with the organic acids that have escaped precipitation or decomposition. The other bases iron and magnesia are not precipitated on defecation, but are completely thrown down during the carbonatation.

Non-nitrogenous organic non-sugar.—This group chiefly includes the organic acids, and of these oxalic acid is quantitatively the most important. It combines on liming to form calcium oxalate, and is partially precipitated. The insolubility of calcium oxalate is not complete in the alkaline juices, the quantity remaining dissolved increasing in direct ratio with the alkalinity, and it is only on carbonatation by reason of the elimination of the excess of lime that it is completely thrown down. The nature and quantity of the numerous other acids occurring in the diffusion juice has not yet been properly investigated; it is known, however, that their amount largely depends on the quality of the beet, its state of maturity, and its preservation. In general it may be stated that the better the quality and the riper the beet, the less the amount of these substances will be present. Usually the juices contain but traces of them, but their amount can rise to a comparatively considerable quantity if unripe, frozen, thawed, or partially decomposed beets have been used, or if extraction has been carelessly conducted. Several of them behave towards lime in a similar manner to oxalic acid; others, on the other hand, remain unaffected, and form soluble lime salts, the solubility of which varies with the temperature. Among those which are better known, the citrate and malate are only completely insoluble at the boiling point of the juice.

The behaviour of another group of non-nitrogenous bodies, the pectic substances, depends greatly on the form in which they occur in the juice. Pectose (Scheibler's meta-arabin) is not met with in diffusion juices but its derivatives assume different forms from neutral pectin to metapectic acid, the quantity of the last named body depending upon the acidity of the juice, the lime, and the length of time and the temperature at which it has been heated. By the action of lime or alkalis the pectin substance is converted into pectic acid, which is the form most usually met with in ordinary practice; this combines with bases present and as in defecation lime is an excess, the pectin and alkaline pectates pass into the form of calcium pectate,

which is insoluble and undecomposable by carbonic acid. In this way therefore the pectin substance is eliminated and goes into the scums.

When the juice contains particles of beet pulp in suspension the danger of the formation of metapectic acid is much increased. This body gives soluble salts with lime, and therefore will remain in solution in the juices. The pectic substance is eliminated the less readily as it is found in a state approaching metapectic acid. For these reasons it is advisable to prevent the formation of this body and this is done by avoiding too high a temperature in the batteries and reheaters, and by carefully eliminating the particles of beet pulp from the juices which are to undergo defecation or carbonatation by employing a good system of pulp separation. The elimination, nevertheless, of pectic substances is never complete however completely these precautions are attended to, and the derivatives of these compounds are always present, in more or less quantity, in the clarified juices.

Raw juices generally contain raffinose and invert sugar in very small quantities, and these two sugars exhibit different behaviour towards lime. The first enters into combination and undergoes no further change, but the second is decomposed and its coloured acid derivatives combine to form soluble calcium salts. The other alkalis also decompose invert sugar, but the degree of their transformation varies with the temperature and the relative proportions of alkali and sugar present. The presence, therefore, of invert sugar in the juices has, as a result, an increase in the coloration of the clarified liquors and the quantity of soluble lime salts. For these reasons it is very desirable to avoid its formation, and this is done by carrying through the extraction, reheating, and liming operations as quickly as possible.

In addition to the above-mentioned non-nitrogenous bodies, the most important of which have been dealt with, it should be mentioned that there are yet others which may be classified as fatty and as aromatic bodies. These, however, are not of great interest from the standpoint of clarification, and exist in but small traces in the juices. The first-named are probably precipitated in liming, whilst the others remain in solution.

As to the colouring matters, chemically but little known, the mechanism of their transformation and removal is hardly capable of being explained; all that can be said of them is that under the action of the lime their amount is considerably reduced, and that this discoloration is rendered more complete during the subsequent carbonatation process.

Nitrogenous non-sugar.—Almost all the nitrogen contained in the beet and in its juice, is found in organic combination; a very small proportion is however present as nitrate. The organic nitrogenous

compounds of nitrogen are more or less complex, but they mainly consist of amides and albumenoids. The principal representative of the former class is asparagin. During the defecation process the amides undergo a more or less complete transformation according to the time and the degree of heating; their decomposition gives rise to the formation of ammonia which is liberated, and certain acids which unite with the free alkali of the juice to form soluble compounds.

The soluble albumenoid matters are also more or less converted into other bodies, and similarly the products formed depend upon the conditions under which the defecation is operated. Peptones and at a later stage amido acids are among the products of the degradation of proteids.

Those albumenoids which have become separated by coagulation during extraction and reheating, do not appear under normal conditions of working to redissolve or undergo any further change under the influence of lime, and in this state they are found unchanged in the filter-press cake.

Neither lime nor the alkalis of the juice exercise any action on those bases of which the most important is betain, and these bodies are found in their original form in the clarified juices, and they ultimately pass unaltered into the molasses.

The transformation of the albumenoids and amides into their derivatives, although it is not complete, is very advantageous to the crystallization of the sugar, for these derivatives give crystalline salts, which are much less melassigenic than the bodies from which they were originally derived, and they moreover diminish the viscoscity of the juice. From this it will be concluded that it is desirable to so carry out the defecation that the degradation of the nitrogenous bodies is as complete as possible, and that the purifying action of the lime will be all the more efficacious as it is prolonged and the temperature is high. It must, however, not be forgotten that there are other constituents of the juice which must not undergo prolonged treatment by lime at a high temperature owing to the danger of their becoming redissolved.

(b) Action of carbonic acid on the limed juices.

For several reasons, the principal of which is to avoid redissolving certain constituents of the non-sugar, the lime must not remain in contact with the defecated juice beyond a certain time; it is therefore eliminated, and at the present day carbonic acid is generally used for this purpose. Almost without exception factories operate according to the Frey-Jelinek procedure, allowing the acid to act on the limed juice directly without separation of the precipitate, which has formed during defecation. Some, however, urge it is better not to filter and to operate on a clear liquor, but this method is difficult and inconvenient to carry out in practice, and moreover experience has shown that quite as satisfactory results can be obtained by directly saturating the defecated juice.

There are certain precautions which must be observed when the lime is eliminated. When the alkalinity of a defecated juice is lowered beyond a certain limit, so that all the lime is completely saturated, it is noticed that the juice which originally was quite brilliant and of a light amber shade, becomes dark and passes to a dirty brown colour; analysis shows that in a liquor thus treated, there is a greater quantity of lime salts present, owing to the redissolving of certain organic lime salts, colouring matter, and non-sugar substances. Thus the clarifying and decolorizing effect of the defecation treatment is destroyed. In practice therefore the saturation of the defecated juices must never be continued beyond a certain limit corresponding to a certain alkalinity; the precipitated matters are then separated and the clear juice then obtained is submitted to a second carbonatation which can be continued without danger until the lime is completely or nearly completely eliminated.

In modern practice the most general custom is to shut off the carbonic acid when an alkalinity of 1 grm. of lime per litre of juice has been obtained, but this amount may be varied according to the composition and concentration of the juice. In factories working juices of high density, alkalinities of 1·3-1·4 grms. are often met with, whilst with those producing juices of lower specific gravity this figure may fall to 0·8-0·9 grms. of lime per litre.

The chemical changes which occur on the introduction of the carbonic acid into the limed juices are not as simple and regular as might be expected, and certain phenomena take place which are as yet imperfectly understood. At the beginning of the operation the gas is readily absorbed by the juices, but this absorption afterwards decreases and the liquors thicken. This is due, it is believed, to the formation of a saccharate combination consisting of calcium carbonate, lime, and sugar, to which certain chemists have given the name of hydro-sucro-carbonate of lime, and others that of sucrate of hydrocarbonate of lime. The composition of this gelatinous body is far from being constant, the ratio between its constituents varying with the relative amounts of sugar and lime in the juices, as well as with the temperature of the saturation. It has further been noticed that the greater the density and sugar content, and the lower the temperature of juices carbonated, the more readily will it assume this gelatinous condition; this explains the difficulties which are often met with when working with dense and insufficiently heated defecated liquors.

This double saccharate which results on the interaction of the carbonic acid with the limed juices is very unstable; the raising of the temperature and the continuation of the action of the gas readily decompose it, and when the saturation has been continued to the normal final alkalinity it has generally entirely disappeared.

It must, however, be pointed out that it is very important to make certain that the carbonatation has been carried far enough, before the

juices are sent to the filter presses; for if otherwise not only would filtration be difficult but the scums would contain a portion of the sugar in the insoluble saccharate. On the other hand, as we have already learnt, excessive carbonatation is also dangerous, for the non-sugar, calcic salts and colouring substances are redissolved.

The calcium carbonate formed during carbonatation is granular, non-viscous, and heavier than the other substances in suspension in the defecated juices; in forming and precipitating it surrounds and helps to carry down the other precipitates formed, so that juices which have been treated with a sufficient quantity of lime and have been carbonated in a rational manner, give on settling or filtration clear and well decolorized liquors and dense and granular scums.

(To be continued.)

CONSULAR REPORTS.

Réunion.

The British Consul reports:—The total production of sugar during the year 1907 was 37,500 metric tons, of which 17,685 tons had been exported up to November 30th. The net price obtained by the planter varied between 22 and 23fr. per 100 kilos. (200lbs.). The price in France averaged for sugar at 88 per cent. 25fr. 76c. To this amount must be added the "Detaxe de distance" of 2fr. 33c. per 100 kilos. and an average exchange of 2 per cent., thus bringing the price obtainable in France up to 28fr. 65c. It can be assumed that the year has been a fairly good one for the sugar planters, and although no great profits can have been realised, yet no losses were sustained. The drought during the latter part of the year will unfortunately have a prejudicial effect on the crop of 1908. There is no doubt in my mind that there is a good profit to be made on the better class sugar estates in the island, provided capitalists could be induced to invest in such estates, to import up-to-date machinery and to work the estates without loans or advances from the bank. With very few exceptions the sugar estates in this island are either owned by planters who have no working capital and are bound to take up heavy advances from the bank on the security of the coming crop, or they are in the hands of a public company with officials and offices in Paris. A capitalist or small syndicate working a sugar estate on simple lines would certainly make a net average yearly profit of from 10 to 15 per cent. This seems a rather startling theory in view of the generally accepted opinion on the subject of sugar estates; I feel, however, fairly confident of the accuracy of my figures, and I should be very pleased to place any British capitalist in communication with experts on the subject. The matter is one which is certainly worth inquiring into.

Germany.

The following tables give the working results of the beet sugar factories and the production and consumption of sugar within the German customs frontiers during the past six campaigns:—

Working Results of Beet Sugar Factories within the German Customs Frontiers.

Campaigns (September 1st to August 31st).	Number of Factories in operation.	Quantity of Beets Treated.	Number of Hectares from which Beets Treated were Harvested.
		Metric tons.	
1901-02	395	16,012,867	478,749
1902-03 (13 months).	393	11,270,978	427,644
1903-04	384	12,677,099	416,877
1904-05..	374	10,071,212	416,714
1905-06	376	15,733,478	471,742
1906-07..	369	14,186,536	446,963

Campaigns (September 1st to August 31st).	Yield of Beets per Hectare.	Raw Sugar (all products) Manufactured from the Beets Treated.	Quantity of Raw Sugar (all products) obtained from One Metric Ton of Beets.
	Metric tons.	Metric tons.	Kilos.
1901-02	33·4	2,182,361	136·3
1902-03 (13 months).	26·4	1,645,444	146
1903-04	30·4	1,822,491	143·8
1904-05..	24·2	1,503,036	149·2
1905-06	33·4	2,314,779	147·1
1906-07..	31·7	2,124,326	149·7

Production and Consumption of Sugar within the German Customs Frontiers.

Campaigns (reckoned from September 1st to August 31st).	Total Number of Sugar Factories.	Total Quantity produced in these Factories in the form of Raw Sugar.	Average Quantity of Beet required to produce a Metric Ton of Raw Sugar.
		Metric tons.	Kilos.
1901-02	447	2,302,246	69·6
1902-03 (13 months).	444	1,789,070	63
1903-04	436	1,921,137	66
1904-05..	428	1,605,438	62·7
1905-06	425	2,400,771	65·5
1906-07..	417	2,242,046	66·8

Campaigns (reckoned from September 1st to August 31st).	Quantity put upon the Market for Home Consumption, reckoned in the form of Raw Sugar.		Quantity per Head of Population calculated in Raw Sugar.	
	Home Sugar.	Home and Foreign Sugar.	Home Sugar.	Home and Foreign Sugar.
	Metric tons.	Metric tons.	Kilos.	Kilos.
1901-02	743,520	745,440	12·94	12·97
1902-03 (13 months).	809,812	811,953	13·84	13·88
1903-04	1,130,326	1,137,189	19·02	19·13
1904-05..	959,607	966,014	15·6	16·07
1905-06	1,125,640	1,128,607	18·44	18·49
1906-07..	1,158,398	1,161,250	18·68	18·72

NOTE.—These statistics comprise beet sugar factories, sugar refineries, and establishments for the treatment of molasses.

As demonstrated by the following table, Germany's foreign trade during the campaign of 1907 shows that, while the importation of cane sugar (raw as well as refined sugar) decreased considerably when compared with that of the preceding year, there were larger imports of raw beet sugar, syrup and molasses. Exports decreased by 41,742 tons, the total being only 1,103,571·4 tons. Raw sugar may be computed at 486,418·4 tons and refined at 555,437·9 tons, compared with 441,816·1 and 633,148 tons respectively in the preceding campaign.

GERMANY'S IMPORTS AND EXPORTS OF SUGAR DURING THE CAMPAIGNS 1904-07.

Year (September 1st to August 31st).	IMPORTS.				
	Raw Sugar.		Refined Sugar.		Syrup and Molasses.
	Cane.	Beet.	Cane.	Beet.	
	Metric tons.	Metric tons.	Metric tons.	Metric tons.	Metric tons.
1903-04	4,013·7	991·9	1,270·7	29·8	89·7
1904-05..	2,083	3,322·2	387·5	13·4	175·5
1905-06	1,592·6	801·9	295·6	10·8	90·7
1906-07..	1,477·9	889·3	220·7	0·5	101·5

Year (September 1st to August 31st).	EXPORTS.				
	Raw Sugar.		Refined Sugar.		Syrup and Molasses.
	Cane.	Beet.	Cane.	Beet.	
	Metric tons.	Metric tons.	Metric tons.	Metric tons.	Metric tons.
1903-04	0·5	419,023·1	0·1	409,139·7	1,952·1
1904-05..	0·1	285,447·9	0·2	432,965·3	1,263·1
1905-06	0·5	441,815·6	0·3	633,147·7	3,199
1906-07..	0·1	486,418·3	0·4	555,437·5	2,772·6

The United Kingdom once more heads the lists of consumers of German sugar in the season of 1906-07, but the quantity consumed was not nearly so great as in 1905-06, 70,560·6 tons of raw sugar and 26,421·1 tons of refined sugar less having been exported to the United Kingdom. Next on the list come the United States with 125,910·8 tons of raw sugar as compared with only 11,798·4 tons in 1905-06. Denmark took 8,315·9 tons of raw sugar more than in 1905-06. The East Indies, owing to greatly increased home production and to imports from Java, have lost much of their former importance as a market for German sugar.

There were exported to Japan 9,688·6 tons less of refined sugar, which, in the campaign under review, imported large supplies from the Dutch East Indies and the Philippines. To Finland, which supplied Russia with its own products, 8,228·2 tons less of refined sugar were sent than in the previous season. The extent of Germany's sugar trade with the principal countries of the world is shown by the comparative figures in the following table:—

EXPORTS OF RAW AND REFINED SUGAR TO THE PRINCIPAL COUNTRIES DURING THE CAMPAIGNS OF 1904-07.

Country.	Raw Sugar.			Refined and other kinds of Sugar.		
	1904-05.	1905-06.	1906-07.	1904-05.	1905-06.	1906-07.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Hamburg	..	0·6	550	1,525	666	24,143
Denmark	13,978	6,986	15,301	1,905	2,916	3,995
United Kingdom	209,581	397,880	327,320	354,387	405,827	379,405
Netherlands	20,906	12,413	8,857	2,199	2,078	2,634
Norway	37	183	123	21,856	27,485	30,006
Sweden	15,879	5,075	94	415	1,197	96
Portugal..	3,087	3,970	2,256	4,741	11,434	11,332
Russia and Finland....	..	537	..	59	21,108	8,511
Switzerland	72	449	149	22,449	22,032	22,455
British Africa	..	..	7	1,564	4,221	3,839
Non-British Africa ..	..	65	11	1,778	12,690	4,825
India	..	1	..	792	45,954	11,765
China and Hong-Kong.	..	1,300	2	1,846	17,019	3,272
Japan	200	849	..	203	13,493	3,805
British North America..	..	..	3	152	284	257
United States	21,704	11,798	125,911	442	338	488
Other parts of America..	..	55	5,823	12,361	32,130	32,075

As regards the current campaign, 1907-08, in four months, September to December, 1907, 13,191,012 tons of beet were manufactured as against 13,849,236 tons during the corresponding period of the preceding season. The production of sugar amounted to 1,908,062 tons as compared with 1,996,994 tons during the period from September to December, 1906.

Since the beginning of the season there has been a noticeable increase in the home consumption, the latter amounting to 418,395 tons, compared with only 403,918 tons in 1906, and 405,389 tons in 1905, and prices, too, are above those ruling in the months of September to December, 1906. Whilst the imports in the first four months of the season of 1907-08 show an increase of 1,521·3 tons over the quantity imported in the corresponding period of 1906, exports dropped off to the extent of 129,099·4 tons.

Although ever-increasing quantities of the sugar produced in Germany are consumed in this country, the industry is in a great measure dependent upon foreign markets. Hence the extension of the Brussels Sugar Convention is a weighty factor in the further development of the German sugar industry.

In view of the great importance of the Sugar Convention, the Imperial Diet assented to the acceptance by the Empire of the supplementary Act and the agreement with Russia, but only on the condition that an Imperial Act be passed, reducing the inland excise rate on sugar from 14 to 10 marks per 100 kilos. after April 1st, 1909. This reduction, however, depends on the passing before April 1st, 1909, of certain legislative measures, by which the revenue of the German Empire is to be increased by at least £1,750,000. If these laws cannot be passed until a later date, the reduction in the sugar excise will also be deferred until such time as the laws are placed on the Statute Book.

The expenditure of the Australian Federal Exchequer for the year ended July 1st last included the sum of £580,000 for sugar bounties.

The sugar industry of Inhambane continues to show a steadily increasing output. Yet surprisingly little attention is paid to this lucrative business though there is a large amount of suitable country for growing sugar cane.

A project is on foot in Pietermaritzburg, Natal, for the establishment of a cane sugar factory having an output of 300 tons of cane per diem, and the sum of £75,000 is reported to have been allocated for the purchase of machinery and plant.

Correspondence.

To the Editor of the "International Sugar Journal."

Sir,—Would any of your readers inform me of the percentage of loss in sugar, when returning seconds and thirds back to the pan, on an estate making only first sugar for refinery?

Our process here in Natal is similar in every respect to the West Indian factories making yellow crystals, the juice being sulphured and limed, passed through the usual clarifiers and triple effect, and on to the vacuum pan.

How much first sugar should I obtain of a nett polarization of say 94 from 100 tons?

50 tons.	Sucrose, 91·90.	Glucose, 1·92.	Ash, ·85.	Nett, 85·73.
50 ,,	,, 88·50.	,, 1·82.	,, 2·10.	,, 76·18.

Our method is to melt the whole in the molasses blow-up tank and skim before taking into the vacuum pan.

I should be glad to hear of the percentage of loss from anyone who has made only one class of sugar, viz., crystals.

Yours very truly,

Sucrose.

18th June, 1908.

ABSTRACTS, SCIENTIFIC AND TECHNICAL.*

Bertel's Process for the Purification of Beetroot Juices and Syrups. *Em. Légier. Sucr. Indigène, 1908, 71, 506-507.*

Demonstrations illustrating the application of Bertel's process for the purification of beetroot juices and syrups were recently given at the Fontaine Valmont Fabrik (Belgium). The trials were carried out on low syrups. The amount of hydrofluosilicic acid necessary for the precipitation of the alkalis was mixed with the diluted syrup cooled to 9-10° C.; after precipitation was effected the product was filtered, this operation being readily accomplished and a perfectly clear liquor obtained. The precipitate was of a dark brown colour, and was composed of potassium fluosilicate together with a quantity of highly viscous organic matters. After neutralization and liming, carbonatation followed, and on filtering highly decolorized and brilliant liquors resulted. The carbonatated syrups were then concentrated and boiled to grain in the pan; the boiling was completed without difficulty, grain forming readily, and a close masse-cuite was obtained.

From the analytical results it is shown that the initial purity improved 4 degrees (76-80), thus indicating that a quantity of highly melassigenic organic matter originally held in solution by the potash had been eliminated.

In these trials low beet syrups were used because juice was not available at this time of the year. The trials on syrups nevertheless demonstrated that all the various operations could easily be carried out on the large scale, and presented no mechanical difficulties whatever. The process should, however, be applied directly to the diffusion juices before liming in order to obtain a more complete purification and greater economy in working.

VACUUM PAN EXPERIMENTS. *F. Langen. Zeit. Ver. deut. Zuckerind., 1908, 441—453.*

These experiments had as their object the exact determination of the steam consumption of a vacuum pan during the whole course of fine and coarse grain boiling. Amongst the number of interesting results obtained may be mentioned the values for the coefficients of heat transmission, which were found to be 29-30 at the beginning of the graining, and 16-19 at the completion of the strike; these figures are higher than those obtained by Claassen when working with raw sugar juices, but this may be easily explained by the higher purity of the syrups, the greater fall of temperature, and the very thorough circulation of the contents of the pan.

SINGLE CARBONATATION. *H. Aulard. Sucr. Indigène, 1908, 71, 536-537.*

From his own experiments and the experience of other investigators, the author advocates single carbonatation; he finds that the usual second and third carbonatations are useless, and that perfectly satisfactory results can be obtained with the single process, provided a careful and accurate control be exercised.

EXTRACTION AND UTILIZATION OF CANE WAX. *M. Grein. Jl. des Fabr. Sucre., 1908, 49, 23.*

It is stated that a cheap and easy method of extracting the wax in a pure condition from the outside of the rind of the sugar cane has been worked out. Suggestions are given as to the way in which this product may most profitably be utilized.

USE OF BARIUM ALUMINATE IN CANE SUGAR MANUFACTURE. *J. Janet* (Fabrik Atalaïa-Maceio, Brazil). *Sucr. Indigène, 1908, 71, 449-450.*

The addition of a small quantity (0·05-0·2 grm. per litre) of barium aluminate to defecated cane juices in the settling tanks was found to

have a distinctly advantageous effect, the syrups obtained after such treatment being perfectly brilliant, well decolorized, and capable of easy filtration; the purity, however, was not influenced in any marked degree.

Drying of Beet Pulp. *H. Aulard.* *Sucr. Indigène, 1908, 71, 514-520.*

A study of the various methods of pulp drying, their cost, and the results obtained by them, with special reference to the conditions prevailing in France.

Compounds of Sucrose, Calcium Oxide, and Calcium Sulphate. *G. Kassner.* *Ber. Pharm. Ges., 17, 243-250.*

An account is given of the preparation and properties of a saccharate of the composition of $C_{12}H_{22}O_{11}$, 2 CaO, $CaSO_4$. As the compound is almost quite insoluble in water, it is suggested that it may be used technically for the separation of sugar in sugar juices, and the conditions under which this salt can be precipitated from pure and impure solutions are described.

Operating on a pure sugar solution to which was added the molecular amounts of calcium oxide and calcium sulphate necessary to form the double saccharate, it was found that after two days 60 per cent. of the sucrose used was contained in the precipitate obtained; with beet juices it was possible to separate in this way about half their sugar content.

New Laevo-Rotatory Body in Beetroot. *J. Weisberg.* *Bull. Assoc. Chim. Sucr. et Dist., 1908, 25, 946-949.*

An account is given of a new laevo-rotatory substance which has been discovered in beetroots, which have undergone change by frost or thaw, or which have become rotten. This substance is precipitable by basic lead acetate and by milk-of-lime, but is not always completely thrown down by the latter reagent. It does not reduce Fehling's solution. It is acid in nature. When boiled with dilute acids its rotation gradually changes until finally it polarizes to the right and reduces Fehling's solution, being thus transformed into a mixture of arabinose and galactose. Again, when distilled with hydrochloric or sulphuric acids furfural is given off.

From these reactions it is concluded that the new substance belongs to the pectic group. As it shows similar chemical properties to the parapectic acid of Herzfeld and Fremy, but possesses an opposite rotation, the author names it "laevo-rotatory parapectic acid."

Separation of Laevulose and Dextrose. *J. Mintz.* *Centr. Zuckerind., 1908, 16, 999.*

Winter's method for the separation of dextrose and laevulose is based upon the properties of the lead compounds of these sugars;

the lead saccharates of dextrose and laevulose, it is stated by this investigator, are both insoluble in water, but the dextrose compound is decomposed by carbon dioxide, the other remaining unaffected.

The author of this paper has recently tested this method of separation following closely the conditions prescribed by Winter, and he finds it to be unreliable, the lead saccharate of laevulose being decomposed by carbon dioxide, although less readily than the corresponding dextrose compound.

BEHAVIOUR OF DEXTROSE, LAEVULOSE AND GALACTOSE TOWARDS DILUTE SODIUM HYDRATE. *J. Meisenheimer. Berichte, 1908, 41, 1009-1019.*

Dextrose and laevulose when dissolved in N/1 sodium hydroxide solution and allowed to stand in flasks, from which air was excluded, for some months at the ordinary temperature were both shown to yield 50-60 per cent. of inactive lactic acid, 0·5-2·0 per cent. of formic acid, and 30-50 per cent. of polyhydroxy acids. Galactose when similarly treated yielded 18 per cent. of lactic acid, a trace of formic acid and about 70 per cent. of polyhydroxy acids. It was further determined that neither sodium sulphite nor potassium cyanide is capable, under the conditions of the experiment, of preventing the coloration of sugar solutions by alkalies, and it is doubtful whether the sulphite has any retarding influence at all on the decomposition of these sugars.

ESTIMATION OF REDUCING SUGARS. *V. Staněk. Böhm. Zeit. Zuckerind., 1908, 32, 497-499.*

The author has so modified the Andrlick-Laxa method of determining reducing sugars, in which the cuprous oxide is reduced to the metal by means of methyl alcohol vapour, that porcelain or copper Gooch crucibles may be used in place of the more expensive platinum apparatus formerly necessary.

REFRACTIVE INDICES OF ALCOHOL AND WATER MIXTURES. *A. Doroszewski. Chem. Centr., 1908, 1, 1375-1377.*

Tables of the refractive indices of alcohol—water mixtures as determined by the Zeiss immersion refractometer at temperatures of 20°, 22°, and 24° C. are given.

VOLUMETRIC DETERMINATION OF THE WATER-SOLUBLE PHOSPHORIC ACID IN SUPERPHOSPHATES. *S. Kohn. Chem. Zeit., 1908, 32, 475-476.*

20 grms. of the sample are extracted with water in a litre flask, then made up to bulk. The liquid is filtered, and 50 c.c. of the filtrate diluted to 300-400 c.c. and titrated against N/10 sodium hydroxide solution (free from carbonate), methyl-orange being used

as indicator; the number of c.c. required are calculated to free phosphoric acid. A large excess of neutral calcium chloride solution is then added, and the titration continued, this time with phenolphthalein as indicator. If m is the total c.c. required, and n the number necessary to convert the free phosphoric into the primary salt, then the total phosphoric acid $= m - n$ c.c.; 1 molecule of P_2O_5 corresponds to 4 of NaOH according to the equation:

$$CaH_4P_2O_8 + 2\,CaCl_2 + 4\,NaOH = Ca_3P_2O_8 + 4\,NaCl + 4\,H_2O.$$

DETECTION OF ARSENIC IN SULPHUR. *J. Brand.* *Zeitsch. ges. Brauwesen, 1908, 31, 33-34.*

5 grms. of the finely powdered sulphur are digested for 15 minutes with 25 c.c. of dilute (1:3) ammonia, and the liquid filtered. The filtrate is evaporated to dryness in a porcelain dish, and the residue treated with a few drops of concentrated nitric acid. After expelling the excess of acid, the contents of the dish are dissolved in 8-10 c.c. of dilute sulphuric acid, and the solution transferred to a moderate sized test-tube; a few pieces of pure zinc are introduced, a wad of cotton wool placed in the upper part of the tube, and the evolved gas tested for the presence of arsenic by means of a piece of filter-paper moistened with a drop of strong (1 : 1) silver nitrate. If arsenic be present, the moistened portion of the paper assumes a more or less orange-yellow colour, which on the addition of water turns black. Pure samples of sulphur should give no coloration after having been heated for 15 minutes in the manner described.

ALKALI SOILS: THEIR NATURE AND RECLAMATION. *F. T. Shutt.* *Bull. Dept. Agric. Ottawa.*

A description is given of the composition and characteristics of the white and black alkali incrustations which form on the soil of the semi-arid districts of Canada and other parts of North America. The different methods of preventing, removing, or lessening the injurious constituents are dealt with. Sugar beets, it is pointed out, are remarkably tolerant of "alkali," and as their growth removes large quantities of the mineral salts they may so far improve the soil as to make it amenable for grain.

Other subjects are:—

USE OF HYDROSULPHITE IN THE SUGAR FACTORY: EXPERIENCE OF THREE CAMPAIGNS AND THE RESULTS OBTAINED. *R. Dutilloy.* *Bull. Assoc. Chim. Sucr. et Dist., 1908, 25, 913-916.*

USE OF SULPHUROUS ACID IN THE SUGAR FACTORY. *J. Weisberg.* *Bull. Assoc. Chim. Sucr. et Dist., 1908, 25, 916-918.*

ABNORMALLY LARGE BEETS. *K. Andrlik and J. Urban.* *Böhm. Zeit. Zuckerind., 1908, 32, 493-496.*

Clarification of Beet Juices using 1 per cent. Lime. *J. Hudec.* *Böhm. Zeit. Zuckerind.*, 1908, 32, 502-506.

Records of Refinery Yields. *H. Fischek.* *Böhm. Zeit. Zuckerind.*, 1908, 32, 499-501.

Use of Phenol-phthalein Indicator in Presence of Sulphur Dioxide. *E. Pozzi-Escot.* *Bull. Assoc. Chim. Sucr. et Dist.*, 1908, 25, 941-944.

Real and Apparent Purity. *J. Weisberg.* *Bull. Assoc. Chim. Sucr. et Dist.*, 1908, 25, 944-946.

New Studies on Diffusion. *L. Naudet.* *Bull. Assoc. Chim. Sucr. et Dist.*, 1908., 25, 950-954.

Utilization of the Residuary Yeast of the Brewery and Distillery. *E. Pozzi-Escot.* *Bull. Assoc. Chim. Sucr. et Dist.*, 1908, 25, 961-964.

Colour Reactions and the Spectroscopic Appearances of Various Sugars. *B. Tollens and F. Rorve.* *Zeit. Ver. Deut. Zuckerind*, 1908, 521-528.

Volumetric Estimation of Tartaric Acid in Tartar and Lees. *E. Pozzi-Escot.* *Compt. rend.*, 1908, 146, 1831-1832.

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. Thompson, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; 77, Market Street, Bradford; and 322, High Holborn, London.

ENGLISH.—Applications.

10615. P. O'Donnell, London. *Improvements in methods of and apparatus for mixing sugar and other materials.* 15th May, 1908.

11845. G. S. Baker, London. *Improvements in machines for boiling sugar and the like.* 1st June, 1908.

12501. L. de Cambourg, London. *Improved protective and advertising covering, especially suitable for portion of sugar.* (Complete specification.) 10th June, 1908.

12703. D. A. Blair and W. Hulme, Glasgow. *Improvements in and relating to apparatus for drying and grading sugar and other like granular matter.* 13th June, 1908.

13702. H. W. Aitken, Glasgow. *Improved roll for sugar cane mills.* 29th June, 1908.

Abridgments.

12762. J. J. Eastick, London, E.C. *A process for purifying and making invert sugar and syrups.* 3rd June, 1907. This invention relates to a process for purifying and making invert sugar and syrups. This process may be described as a diffusion process assisted by electrolysis, but the electric current will not operate until some diffusion has taken place (unless some acids or salts have been added to the water surrounding the electrode where the impurities are

eliminated). The impurities found in a sugar solution are constantly undergoing electrolytic dissociation, but the products cannot be separated by ordinary diffusion on a practical scale, but this separation takes place rapidly (according to the diffusion velocity) if the solution is electrolysed and a small amount of electric endosmose or cataphoresis takes place at the same time. It will be seen that in this new process, generally at the beginning only diffusion is operating, during the middle and greater portion of the operation diffusion with electrolysis. Near the end diffusion.

18341. G. Ekström, Limham, Sweden. *An improved process for making grape-sugar (glucose) and ethyl-alcohol from materials containing cellulose.* 13th August, 1907. This invention relates to a process for making grape-sugar and eventually ethyl-alcohol from substances containing cellulose such as common waste wood, sawdust, peat, moss, straw, or other similar materials, by which process the cellulose first, by the action of a concentrated mineral acid at an ordinary temperature and at atmospheric pressure, is converted into acid-cellulose, which then by boiling with a dilute mineral acid under a somewhat higher pressure than that of the atmosphere, or by the addition of concentrated mineral acid, and heating to a temperature not above 100° C., and finally by the addition of water and boiling at atmospheric pressure, is converted into grape-sugar.

19633. A. Boidin, Seclin (Nord), France. *Improvements in the treatment of grain and amylaceous material previous to saccharification.* 2nd September, 1907. This invention relates to a process for treating amylaceous materials wherein the mass while being heated is submitted, when it has reached a suitable state of hydration, to a sudden and sufficient expansion in order to produce an effective disaggregation of the groups of cells for the purpose of rendering efficacious, during the second period of heating under pressure, the action of heat on each of the starch grains, thereby avoiding all loss and rendering the residue capable of being filtered in a filter-press without any special treatment.

22500. W. Mackie, Partick, Renfrew, N.B. *An improved figured roll for sugar cane mills.* 12th October, 1907. This invention relates to a roll for a sugar cane mill having upon its surface triangular pyramidal figures, that is to say pyramids of triangular base, and it is to be pointed out that this particular form of figure offers more outlets for juice than any other similar geometrical figure.

214. M. Hoff, Zloczow, Galicia, Austria. *Improvements in or relating to the manufacture of sugar from starch substances.* 3rd January, 1908. This invention relates to a process for the saccharification and conversion into dextrose of substances containing starch, characterised by a suitable food substratum infected with oidium lactis, being left for the development of the fungus, the whole oidium

substratum being then mixed with water with addition of malt or malt diastase and used for saccharification.

GERMAN.—Abridgments.

196079. Heinrich Korán, of Meziric, near Opocno, Bohemia. *An apparatus for carrying out the process for separating sugar beet from foreign bodies.* 26th July, 1907. (Patent of Addition to Patent No. 155224, of 27th February, 1904.) This apparatus is designed for carrying out the process described in the original Patent No. 155224 and consists of a spiked drum being revolubly mounted in a compartment filled with water or the like and its spikes fixed on common bars, which at both ends are provided with pins which are carried by means of guide blocks in slide grooves eccentric to the roller, so that the spikes when in the water entirely protrude and on emerging above the level of the water retract into the roller, thus producing the result that the leaf fibres and weeds caught by the spikes remain lying on the surface of the roller when the spikes retract into the roller and are conveyed by a scraper knife into a gutter or channel.

196417. H. Eberhardt, of Wolfenbüttel. *A pulp separator for pressed shreddings and the water of diffusion, having a rotary cylindrical sieve.* 27th October, 1906. In this apparatus the pulp separator is closed by a pulp press in such a way that the pulp separated in the sieve passes directly into the press.

196668. Hans Mathis, of Ottleben, District of Oschersleben. *A sugar juice crystallizing apparatus having an external heating jacket.* 5th February, 1903. In this apparatus the heating jacket entirely or partially surrounds the crystallizing vessel and is provided on its outside with a second jacket serving for heating air passed through it, the inner chamber of which is connected by means of pipes with distributing chambers preferably arranged outside the crystallizing vessel.

196826. John Teoder Lindahl and Carl Axel Halling, of Stockholm. *A centrifugal drum having discs or rollers travelling round the inside, which in their rotation expel the deposited sludge through discharge apertures provided on the periphery of the drum.* 29th December, 1906. In this drum for a centrifugal as described in the title, the characteristic feature is that the discs or rollers are provided with inequalities such as teeth or the like on their edges, so as to increase the action.

197110. Société d'Études Spéciales et d'Installations Industrielles, of Paris. *A revoluble drying drum, in the interior of which a group of drying bodies is arranged which throw to one another the material to be dried.* January 20th, 1907. In this drying drum the material is thrown from one drying body to the other and each

drying body is constituted by a prismatic tube, the sides of which are all prolonged outwardly in the same direction, so that they form wings over the entire length of the tube, each tube with its wings having a spiral form.

197146. WILLIAM MYLES CUMMER, of Cleveland, U.S.A. *A drying drum consisting of several longitudinal parts of segmental section which are separated from one another by elongated narrow apertures.* 15th May, 1907. The chief characteristic of this drying drum is that these apertures are surrounded by suction chambers projecting into the interior of the drum and provided with longitudinal walls, which suction chambers prevent the material escaping through the narrow apertures and also form lifting scoops. Another feature of the drying drum is that the walls of the suction chambers may be inclined or curved.

197494. FREDERICK NOBLE and FREDERICK WIETZER, of Rocky Ford, Colorado, U.S.A. *An apparatus for removing the foreign bodies, more particularly from sugar beet.* September 23rd, 1907. This invention relates to an apparatus for removing foreign bodies, more particularly from beetroot, and it is characterized by movable bars of similar shape lying on rollers in the plane of fixed bars if desired provided with teeth, in combination with separating rollers having spiral fingers arranged on them, which engage through the intervals which remain between the fixed and the movable bars.

Great hopes are entertained of several large new sugar plantations in Beira (Mozambique); but the prevalence of locusts makes this form of cultivation rather precarious. A new company has recently been formed in London to work some sugar estates out here.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of June, 1907 and 1908.

IMPORTS.

Raw Sugars.	Quantities.		Values.	
	1907. Cwts.	1908. Cwts	1907. £	1908. £
Germany	4,282,364	3,656,979	2,002,560	1,942,906
Holland	83,963	97,906	37,715	48,521
Belgium	203,048	90,509	90,529	47,826
France	226,029	184,249	114,534	110,165
Austria-Hungary	263,701	409,455	118,617	219,221
Java	157,101	454,270	82,521	231,525
Philippine Islands	143,916	177,079	60,000	71,202
Cuba	91,113	....	39,600	....
Peru	232,529	611,755	110,417	333,006
Brazil	185,478	1,712	76,570	788
Argentine Republic	....	....	....	....
Mauritius	358,229	351,960	146,839	155,695
British East Indies	67,873	144,429	30,468	62,932
Straits Settlements	105,921	74,344	44,251	33,257
Br. W. Indies, Guiana, &c.	951,235	599,222	552,108	425,488
Other Countries	464,073	424,593	230,453	236,847
Total Raw Sugars	7,816,573	7,278,462	3,737,182	3,919,379
Refined Sugars.				
Germany	6,714,199	7,130,057	3,943,457	4,591,115
Holland	1,303,498	1,227,747	816,981	831,531
Belgium	159,237	93,175	96,697	60,832
France	1,842,884	1,064,509	1,072,103	708,125
Other Countries	1,558	124,544	1,142	82,288
Total Refined Sugars	10,021,376	9,640,032	5,930,380	6,273,891
Molasses	1,415,087	1,239,790	268,976	250,873
Total Imports	19,253,036	18,158,284	9,936,538	10,444,143

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	292	673	220	280
Norway	7,450	5,180	4,431	3,326
Denmark	55,280	54,395	29,572	33,049
Holland	36,228	33,081	24,225	23,691
Belgium	4,326	3,648	2,566	2,506
Portugal, Azores, &c.	13,081	7,222	7,204	4,434
Italy	11,111	4,254	5,828	2,533
Other Countries	226,940	132,915	167,270	104,273
	354,708	241,368	241,316	174,092
Foreign & Colonial Sugars				
Refined and Candy	16,242	8,933	10,799	6,869
Unrefined	47,811	34,833	28,535	22,062
Molasses	4,031	1,874	1,16[illegible]	739
Total Exports	422,792	287,008	281,811	203,762

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1908. Tons.		1907. Tons.
Total Receipts Jan. 1st to July 16th ..	1,193,292	..	1,278,875
Receipts of Refined ,, ,, ...	610	..	620
Deliveries ,, ,, ...	1,170,204	..	1,241,380
Importers' Stocks, July 15th	28,708	..	37,495
Total Stocks, July 22nd	265,000	..	326,430
Stocks in Cuba, ,, ...	98,000	..	179,000
	1907.		1906.
Total Consumption for twelve months..	2,993.979	..	2,864,013

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1907 AND 1908.

(Tons of 2,240lbs.)	1907. Tons.		1908. Tons.
Exports	1,130,255	..	774,884
Stocks	239,151	..	130,841
	1,369,406	..	905,725
Local Consumption (6 months)	22,970	..	28,990
	1,392,376	..	934,715
Stock on 1st January (old crop)	....	..	9,318
Receipts at Ports up to June 30th	1,392,376	..	925,397

Havana, June 30th, 1908. J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR SIX MONTHS, ENDING JUNE 30TH, 1908.

SUGAR.	Imports 1906. Tons.		Imports 1907. Tons.		Imports 1908. Tons.	Exports (Foreign) 1906. Tons.		Exports (Foreign) 1907. Tons.		Exports (Foreign) 1908. Tons.
Refined	432,512	..	501,069	..	482,001	1,093	..	812	..	447
Raw	421,105	..	390,828	..	363,923	5,920	..	2,391	..	1,742
Molasses	66,723	..	70,754	..	61,989	265	..	202	..	94
Total..........	920,340	..	962,651	..	907,913	7,278	..	3,405	..	2,283

	Home Consumption 1906. Tons.		1907. Tons.		1908. Tons.
Refined..	411,749	..	472,461	..	457,747
Refined (in Bond) in the United Kingdom	276,624	..	243,392	..	256,402
Raw	59,701	..	60,026	..	57,845
Molasses	62,977	..	61,780	..	60,829
Molasses, manufactured (in Bond) in U.K.	30,926	..	33,867	..	35,240
Total..................................	841,977	..	871,526	..	868,063
Less Exports of British Refined.....................	22,407	..	17,735	..	12,068
Total Home Consumption of Sugar	819,570	..	853,791	..	855,995

STOCKS OF SUGAR IN EUROPE AT UNEVEN DATES, JULY 1ST TO 18TH. COMPARED WITH PREVIOUS YEARS.

IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	TOTAL 1908.
188	554	331	382	96	1550

	1907.	1906.	1905.	1904.
Totals	1729 ..	2033 ..	1436 ..	1895

TWELVE MONTHS' CONSUMPTION OF SUGAR IN EUROPE FOR THREE YEARS, ENDING JUNE 30TH, IN THOUSANDS OF TONS.

(Licht's Circular.)

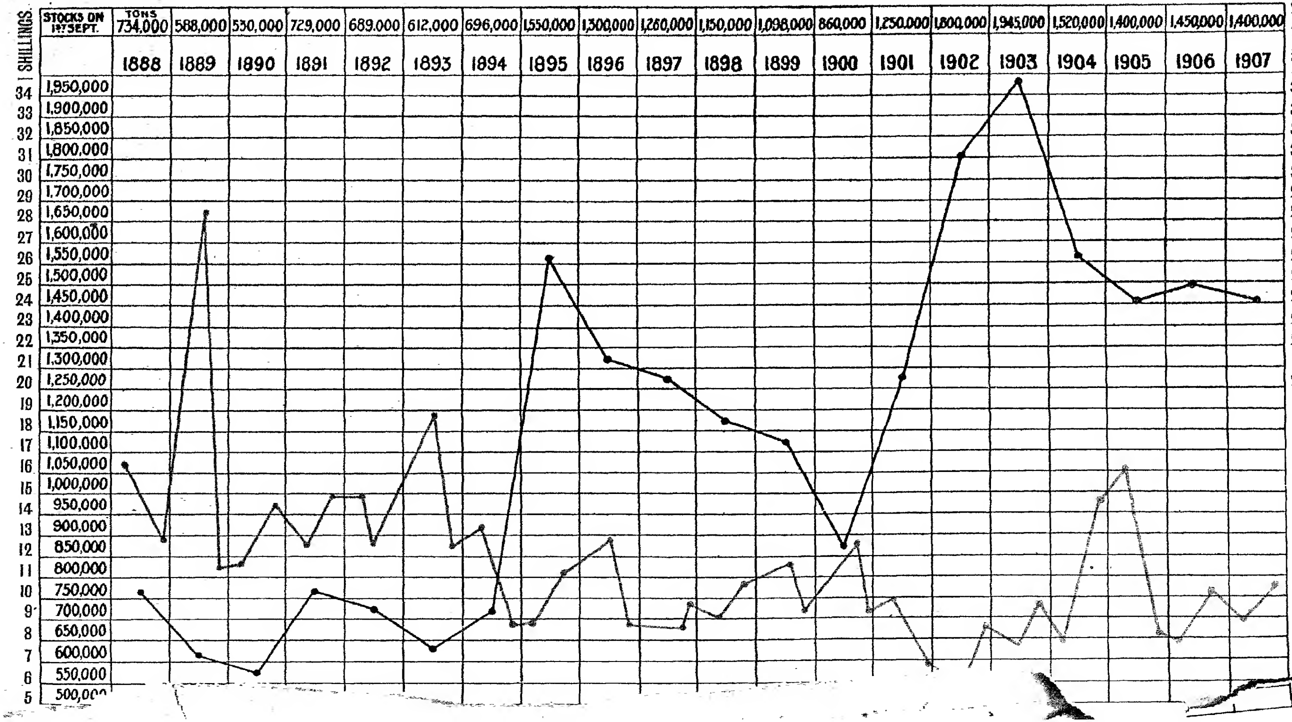
Great Britain.	Germany.	France.	Austria-Hungary	Holland, Belgium, &c.	Total 1907-08.	Total 1906-07.	Total 1905-06.
1875	1178	652	545	200	4451	4533	4143

ESTIMATED CROP OF BEETROOT SUGAR ON THE CONTINENT OF EUROPE FOR THE CURRENT CAMPAIGN, COMPARED WITH THE ACTUAL CROP OF THE THREE PREVIOUS CAMPAIGNS.

(From Licht's Monthly Circular.)

	1907-1908. Tons.	1906-1907. Tons.	1905-1906. Tons.	1904-1905. Tons.
Germany	2,132,000 ..	2,239,179 ..	2,418,156 ..	1,598,164
Austria	1,430,000 ..	1,343,940 ..	1,509,789 ..	889,431
France	725,000 ..	756,094 ..	1,089,684 ..	622,422
Russia	1,410,000 ..	1,440,130 ..	968,500 ..	953,626
Belgium	235,000 ..	282,804 ..	328,770 ..	176,466
Holland	175,000 ..	181,417 ..	207,189 ..	136,551
Other Countries .	435,000 ..	467,244 ..	410,255 ..	332,098
	6,542,000	6,710,808	6,932,343	4,708,758

The black line denotes the world's visible supplies on Sept. 1st in each year. The red line denotes the price per cwt. of 88% beet f.o.b. Hamburg. When the black line rises, production is exceeding consumption; when it falls, consumption is exceeding production.



THE

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☞ All communications to be addressed to the Editor, Office of "The Sugar Cane," Altrincham, near Manchester.

All Advertisements to be sent direct.

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NOTICE TO READERS.—If the Advertisement pages stick together, bang their edges on the table, when they should easily separate.

NOTES AND COMMENTS.

The Contest between Production and Consumption of Sugar.

Just five years ago we supplied our readers with an interesting diagram illustrating the contest between production and consumption and the consequent fluctuations in the price of sugar. We have now brought the diagram down to date; but exigencies of space have obliged us to omit the four years 1884-1887. A reference to our issue of June, 1903, will however supply this omission, in the case of those of our readers who have copies of that year. With regard to the present diagram, a few words by way of amplification will not be out of place here.

The great rise in price in the winter of 1904-5 was caused by a falling off in the beetroot crop of 1,200,000 tons, owing to drought. This great loss of sugar was expected to have a very serious effect on the visible stocks of the world in September, 1905. But, as on former occasions, the rise in price had the desired effect; consumers abstained from buying and lived on invisible stocks, while producers sowed and reaped the largest crop on record. This averted the expected scarcity and prices fell to the former level; impelled not only by the facts but still more by the usual violent reaction after a period of wild speculation. Since then prices have occasionally been affected by anticipations of short crops.

Sugar Beet Growing in England.

There has lately been some renewal of the discussion in the press on the question of establishing a beet sugar industry in this country. A correspondent, who wrote to the Board of Agriculture suggesting that the Government should give encouragement to the cultivation of sugar beet in the south and east of England where the prospects were alleged to be bright, was met by a cold *non possumus*. The Board had arrived at the conclusion that the profitable nature of the undertaking would be too doubtful to warrant their giving it any support. On what grounds they had arrived at this conclusion we are not told, but it seems apparent that they have based their calculations solely on the failure of the sporadic attempts to start such an industry some 40 years ago when bounties reigned supreme. The publication of this reply in the press brought forth a very pertinent letter to *The Times* from Mr. George Martineau, which we reproduce on another page. He rightly draws attention to the very large volume of trade, direct and indirect, brought into existence by the sugar industry abroad, and the general benefit to the land from this intensive form of cultivation; and then comments on the astonishing indifference of our statesmen and capitalists to the possibilities of our securing a share of this wealth. Probably, however, Sir Nevile Lubbock is right when he points out that the one consideration essential to success is wanting, viz., the question of security. The Brussels Convention as altered by the Liberal Government has once more thrown open our markets freely to subsidized sugar, and as long as this state of affairs continues there can be no security for capital whether invested in the sugar or any other industry. And it is a foregone conclusion that as long as the present Government is in office they will do nothing to tamper with their Free Trade theories, so that it seems to us a pure waste of time and ink, agitating in the press for Government support. If the next Government are committed to Tariff Reform, they will lend a much more favourable ear to our agriculturists' demands.

The Formosan Sugar Industry.

The *Journal* of the Yokohama Chamber of Commerce (Japanese) states that the sugar refining industry of Formosa has shown marked development of late under the encouragement of the Formosan Government, and that the output for the next season is estimated to reach a total of about two hundred million kin (1 kin equals 1·32 lb. av.). The installation of plant in the refining factories will be completed shortly, and the machinery will all be in working order before next season. The sugar plantations now cover an area of about 4,000 cho (1 cho equals 2·45 acres), while 80 to 85 per cent.

of the area is planted with superior canes introduced from abroad. Calculating the total yield of cane at 216,000,000 kin, it is possible to obtain 192,000,000 kin of refined sugar.

A New Formosa Company.

While on the subject of Formosa, we may add that a Company has lately been in process of formation in this country to acquire the business of Messrs. Bain & Co., of Anping, Formosa, an old-established British firm in that Island. The new Company is called The Formosa Sugar and Development Co., Ltd., and the directors consist of the three partners of the old firm and Mr. H. I. Roberts, M.I.M.E., of Liverpool. They have taken over Messrs. Bain's sugar mill and factory, and the area allotted to them by the Japanese Government of 7460 acres, 6000 of which are available for planting cane. They have, moreover, concluded contracts with farmers in this area to supply the mill for 20 years. The position of the district is particularly favourable, as they are within easy reach of Anping, the port of shipment. New machinery has recently been added to the existing mill, bringing up the daily output to 300 tons. Providing the Company can secure a good and steady market for its sugar, its prospects seem reasonable enough. The offices in this country are at 42, Castle Street, Liverpool. An issue of 25,000 six per cent. £1 preference shares at par was offered in July last and may still be open.

Russian Statistics.

H.M. Consul at Kieff (Mr. H. P. Smith) reports that the area under beetroot in European Russia on the 1st-14th June last is given by the Russian Association of Sugar Manufacturers as 511,544 dessiatines (about 1,406,746 acres), a decrease of 54,161 dessiatines (about 148,943 acres) as compared with the area on the same date in 1907. The condition of this area is said to be as follows:—48·4 per cent. excellent, 37·1 per cent. good, 14·5 per cent. indifferent. There will be 277 factories in operation, as against 275 in 1907. H.M. Embassy at St. Petersburg reports the publication in the *Official Messenger* of the 27th June-10th July of a ministerial decree confirming the statements in the St. Petersburg press of the 9th-22nd April, and fixing the normal output of sugar, *i.e.*, that destined for home consumption, at 71,000,000 pouds (about 1,145,160 tons) for the season 1908-9.—(*Board of Trade Journal.*)

Crop Prospects.

The news to hand from Cuba and Porto Rico speaks well of the prospects of the coming crops; the weather has been favourable of late, and there has been a fair amount of rain. Cuba's crop will exceed the previous one by anything from 150,000 to 200,000 tons.

According to de Silva, Java expects an outturn of 1,200,000 tons (or slightly less than last year); Argentina a small crop and the necessity to import again; Mauritius 180,000 to 200,000 tons against 170,000 tons; Brazil may have a little to export, and Louisiana's crop will be at least equal to the last. Turning to Europe, the latest returns indicate that the total European beet area amounts to 1,778,400 hectares, or 4·7 % less than last year, so that it will require a yield superior to that of the past two years to produce a crop equal to the last.

Duties on Russian Sugar.

The Board of Trade have received information, through the Colonial Office, to the effect that the Government of the Cape of Good Hope are of opinion that although Russia will be admitted as a Contracting Party to the Brussels Sugar Convention after 1st September, it will not be possible to permit the importation into the South African Customs Union of sugar originating in Russia, whether refined elsewhere or not, without levying a countervailing duty thereon, until that country adheres to the Sugar Convention on the same terms as the other Signatories. On the other hand, other official advices state that the countervailing duties in India assessed on Russian bounty-fed sugar will be abolished, in response to the removal of the special duty upon Indian tea imported into European Russia.

THE CULTIVATION OF THE SUGAR BEET.

The following letter appeared in *The Times*, apropos of the publication of a communication from the Board of Agriculture declining to offer any support to the establishment of a beet sugar industry in this country. It is well worth reproducing as it sets forth succinctly the advantages to any country of such a form of agriculture:—

To the Editor of the Times.

Sir,—The letter from the Board of Agriculture on this subject which you published on August 3rd gives rise to serious reflections.

The production of sugar from the sugar beet throughout a large portion of our neighbouring European countries has become one of the most important agricultural industries of those districts. In Germany, Russia, Austria-Hungary, France, Belgium, Holland, Sweden, Denmark, Italy, Roumania, and Spain between six and seven million tons of sugar are annually produced. The visible production and consumption of the world, not including British India, is about 12,000,000 tons; so that this vast European industry produces more than half the world's visible consumption.

This industry not only gives employment to farm labourers on a large scale, but also furnishes work to great numbers of skilled and unskilled men and women in the factories where the sugar is extracted from the

roots. Numerous subsidiary industries flourish in supplying all things necessary for this production and manufacture. Artificial manures and implements for the field work, elaborate machinery for the factories, bags for packing the finished sugar, are only a few of the many necessaries of this great industry.

Then we must not forget the great benefit to the land from this intense culture. It is a well-known fact that since this industry began, the crops of wheat in those districts have become much heavier. A largely increased head of cattle has been fed by the refuse pulp of of the root. Great industries have sprung up for dealing with the molasses and other by-products of the factory.

The United Kingdom, it has been conclusively proved, is just as well suited for the production of sugar beet as any of the countries I have enumerated; and the industry, if it were established here, would have the great advantage over all other competitors that it would have, at its very doors, an annual demand for 1,600,000 tons of sugar.

With all these facts staring us in the face, it is incredible that the British capitalist should fold his arms and look on. But it is still more incredible that statesmen should persistently throw cold water on every suggestion that the country which consumes the sugar should be the one most active in producing it. In the House of Lords, not long ago, such a suggestion was met by a noble lord, a member of the Government, with the casual remark that in any case the industry would be a very small affair, not worth much consideration. He was evidently quite unaware of the facts I have just stated.

And now we have the Board of Agriculture, with more wet blankets, assuring us that it appears doubtful "whether the industry would prove to be a profitable one." They give no valid reason for this decision.

Those who are qualified by long experience to give an opinion know that the roots can be grown here under exactly the same conditions as those produced on the continent, and of equally good quality. The only serious attempt that has been made in this country to produce beetroot sugar was made, in the early days of the industry, more than 35 years ago. It was done on a small and imperfect scale, but was successful so far as it went. The factory was closed for reasons quite apart from any question of success or failure of the experiment. Subsequent attempts to reopen the factory were not of such a kind as to ensure success.

Any one who would take the trouble to make a tour of some of the beetroot districts on the other side of the Channel would inevitably conclude that this country is entirely out of it in the industrial race so far as the land is concerned. Some day, perhaps, we shall wake up and begin to think that we might with advantage make some of our own sugar on our own land and with our own labour.

I am, Sir, yours faithfully,

GEORGE MARTINEAU.

Gomshall, Surrey.

The Norwegian Storthing have reduced the sugar duty by ten ore per kg.

A SKETCH OF THE TECHNICAL DEVELOPMENT OF THE SUGAR INDUSTRY DURING THE LAST TWENTY-FIVE YEARS WITH SPECIAL REFERENCE TO CANE SUGAR.*

By NÖEL DEERR.

The year 1884, which is almost twenty-five years ago, is noticeable in the history of the cane sugar industry because in this year there occurred a great fall in prices due to the competition of the beet sugar industry; gradually from this time on the feeling grew amongst those connected with the cane sugar industry that this competition could only be met by improvements in the methods employed; my connection with the cane sugar industry only dates back to 1896 and much of the information I have collected has been obtained from a study of the literature of the industry and from conversations with men older than myself. I propose in what follows to consider my subject detailed under separate headings.

EXTRACTION OF SUGAR FROM CANES.

A quarter of a century ago a six-roller mill with an inefficient maceration was typical of a then up-to-date factory, and a very large proportion of the world's output of cane was treated in single three-roller mills; averaged over the whole output, I doubt if more than 80% of the sugar in cane was extracted. At the present moment in Java, in Mauritius, in Cuba, in Fiji, in Queensland, and in the Hawaiian Islands, an extraction averaging from 90% to 95% is regularly obtained from the canes crushed in nine-roller mills, and in some few cases the nine-roller mill has been superseded by the twelve-roller mill with results that are, I believe, to be considered eminently satisfactory. As adjuncts to the milling plant, proper reference must be made to the various crushing or shredding devices which are indispensable when working certain varieties of cane; a very late development of the crusher consists in the replacement of the top roller of the first mill by a heavily indented roller similar to those in the well known Krajewski type of crusher, and privately I have heard that this scheme is quite successful.

During the period under review the diffusion process has risen into prominence, has been thoroughly tried and has been almost entirely abandoned as unsuccessful; a diffusion plant has, however, been erected in Brazil during the year 1907, so that the process cannot be considered as defunct. The combined milling and diffusion process due to Naudet has been erected in a fair number of factories, but up to the present I have come across no independent detailed accounts of the results obtained; private reports of this process to which I have

* Read at a meeting of the Hawaiian Chemists' Association held in Honolulu on May 16th, 1908.

had access lead me to the conclusion that its success or otherwise still remains *sub judice*.

Clarification.

Numberless combinations of chemicals, for many of which extravagant claims are made, have been proposed (and still are being proposed) during the past 25 years. Of the earlier proposals the only one which has been to any extent adopted is the use of phosphoric acid; the credit of the introduction of this material is, I believe, due to Mr. Ehrmann, who first used this substance in the manufacture of white sugars in Mauritius, in or about 1884; other processes that deserve mention are the use of hyposulphites as bleaching agents of which very favourable reports have been published, and the removal of potash salts from sugar juices as fluosilicates and by filtration through natural and artificial zeolites, as instanced in the patented processes of Harm, of Rumpler and of Gans.

The carbonatation process has been erected and successfully worked in a few instances, notably in Java, but there does not seem any prospect of its extended adoption. The Naudet process of juice extraction also introduces a new method of clarification in that the juices are filtered through their own bagasse, and the clarifiers and filter presses are eliminated from the factory; from reports of disinterested parties I am able to say that this claim is quite well-founded.

Filtration.

The frame filter press long antedates the period under review; but it has received many improvements, chiefly towards the end that the cake may be completely washed in the press; what is known as "mechanical filtration," *i.e.*, the filtration of juices *en masse* that have already been separated from the bulk of the scums, is largely a matter of the last quarter of a century; of the materials used megass, coke, gravel, lignite, sand and finally wood shavings may be mentioned.

Multiple Evaporation.

The conception of the idea of multiple evaporation in vacuum and the invention of apparatus to put into practice the principles therein contained may properly be attributed to the cane sugar industry, the inventor of this scheme being Rillieux of Louisiana; although he introduced his ideas more than 50 years ago it is not much more than 25 years since the scheme was adopted in either cane or beet sugar industry; considerable merit for its adoption belongs to the French firm of Cail, who, when selling the earlier plants they constructed, received payment based on the actually obtained reduction in fuel consumption, precisely as Watt, a hundred years earlier, had sold pumps to the Cornish miners. The first triple in the British West Indies was erected in Demerara in 1880, and the apparatus was in use one or two years earlier in Java; although the original apparatus was of the horizontal submerged tube type it was soon

replaced by the vertical submerged tube type, so much so that it is allowable to refer to the latter as the "standard" type. The earlier "standards" were remarkable for great length of tube, small vapour space, vapour pipes of restricted area, unequal distribution of steam and insufficient circulation of juice; syrup pumps were not at first used, the concentrated juice being removed intermittently by montjus; the vapour piping was so arranged that any one vessel could be shut off and in each vapour pipe "save-alls" were fitted; to one used only to a modern "standard" effect the arrangement of valves and piping gave to the apparatus a complicated and weird appearance. In all the earlier apparatus the evaporation per unit of heating surface was very small, seldom exceeding from 3 to 4 pounds of water per square foot, and losses from entrainment were very considerable.

With the rapid adoption of the apparatus, improvements in design soon followed, attention being paid to the shortcomings detailed above, so that at the present time "standard" triple effect evaporators with a duty of 10 pounds' water per square foot of heating surface and no appreciable loss in entrainment have resulted; 10 or 15 years ago it was frequently held that the limit of evaporative economy was reached with a triple and that with four vessels the duty was too low to allow of the successful use of a quadruple, an idea quite opposed to recent practice.

It is impossible even to refer to the many minor differences in design that have been applied to the "standard" evaporator; the devices thought out so as to obtain a "grimpage" or "ruissellement" of the juice and those designed towards the prevention of a deposit of scale may, however, be referred to. The earliest radical alteration from the "standard" design is to be found in the Welner-Jelinek horizontal tube evaporator; apparatus very similar in design are made by more than one American firm. In this pattern the steam or vapour circulates within horizontal tubes of great length, the liquor undergoing treatment being external to the tubes; in this the apparatus was designed so as to obtain a low level of juice and a large vapour space and a duty much higher than that in the earlier "standards" was obtained.

After the Welner-Jelinek, the next real departure was the apparatus of Yaryan, which has, by this time, passed into disuse; a contemporary inventor of Yaryan, and involved in law suits with him, was S. Morris Lillie, to whom is due the apparatus known by his name; the apparatus of both Yaryan and Lillie are "film" as opposed to "bulk" evaporators, but the relative positions of steam or vapour and of the liquid are transposed in the two cases; in the Lillie the liquid is external to the tubes; in the latest pattern of this apparatus the direction of the liquid is capable of reversal and the quadruple can be worked when necessary as two doubles. The latest mechanical invention to attract notice is the apparatus of Kestner; this is very

fully described in the Bulletin de l'Association des Chimistes de Sucrerie et de Distillerie, Volume 24, page 1044, and is the very latest development of the principle of "grimpage" or "ruissellement." I should also refer to the Meyer & Arbuckle sprinkling device, of which I have heard very favourable reports.

So far I have only mentioned developments in the mechanical construction of evaporators, but quite recently very important methods of utilizing heat, whereby great economy of fuel is obtained, have been adopted in the beet sugar industry, and to my personal knowledge in one West Indian factory; the first method to which I shall refer is also due to Rillieux and may be described as the "extra steam" method. In this scheme the first vessel of the multiple is provided with a heating surface much larger than that in any of the subsequent vessels; the heating surface may be so large that, say half the evaporation from juice to syrup is done in the first vessel; all the generated vapour is not passed on to the second vessel, but a portion is removed and is utilized in such places as the reheaters of the diffusion and carbonation plants; in a triple, if half the evaporation be done in the first vessel then one quarter will be done in the second and third vessels respectively, and in each of these the heating surface will be one-half what it is in the first; actually in the evaporation proper more steam is used but the economy is obtained by the two-fold use of the "extra steam" in the diffusion plant, &c.; in recent actual designs this scheme is applied to quadruple effects and "extra steam" is taken from both first and second vessels.

The scheme so briefly described above has been further developed by Pauly, who has introduced the "Vorkocher," which can best be rendered "Pre-" or "Fore-evaporator." In this scheme the juice first enters a single effect evaporator in which it is heated with steam of 30 pounds or so pressure; the liberated vapours are at a pressure of about 15 pounds, and these pass on to the juice heaters, the vacuum pans and to the first body of the multiple effect proper; two sets of boilers are provided, one for supplying steam to the engines and one working at a lower pressure to supply steam to the pre-evaporator; in addition to steam economy there is a saving in steam piping, but on the other hand very large heating surfaces are required in the vacuum pan proper.

Pumps.

At an early stage the horizontal pump displaced the vertical pump and the wet vacuum pump of low efficiency has been replaced by the dry vacuum slide valve pump; in fact with installations of any size the adoption of the dry vacuum is essential unless the pumps are to be of enormous dimensions; the pressure equalizing devices used in the slide valve pumps and developed initially by the German firms of Wegelin and Hübner, and Burchart and Weiss afford an almost theoretical efficiency, and these pumps have made central condensation,

with all its economies of steam and labour, possible. A return to the vertical pump, as seen in the widely used Edwards pump, should be mentioned.

Vacuum Pans.

From the time of its invention until a comparatively recent date the vacuum pan underwent little change, the heating surface remaining as tubes of great length; in such a design much of that portion of the tube remote from the steam inlet is ineffective; pans with heating surfaces of this type are, however, still made. One of the earliest attempts to obtain a more effective heating surface is to be found in the Greiner patent, which combines great heating surface with short coil length; a similar effect is obtained in the "lyre shaped coil" pans which are now very extensively built and are not dissimilar in conception to the short coil pans built by the Honolulu Iron Works and designed by Max Lorenz. Equally good results are obtained with pans when the heating surface is tubular and follows the lines of that in the "standard" vertical evaporator.

It is in the technique of pan boiling that the most radical changes have been made; twenty-five years ago almost every factory obtained its product by repeated boilings of the syrup, first molasses, &c., and shipped as many sugars as there were boilings. Our modern tendency is to suppress all the later boilings and to ship but one product, a result best obtained, not by remelting the low grades, but by their absolute suppression. This process, which is properly known as the "First Sugar and Molasses" process, depends on the use of crystallization in motion and can only be successful when operated under systematic control based on a study of the principles of crystallization. Like all other processes, this scheme as used at present is not the work of any one inventor; the most prominent names in connection with its development are those of Manoury, Huch, Bock, Wulff in the beet sugar industry, and of Winter and Geerligs in Java. The successful practice of a "First Sugar and Molasses" process is much facilitated by the use of the "Brasmoscope," invented by Curin in 1899, and the use of which has been much extended by Claassen.

Centrifugals.

The history of developments of centrifugals during the past twenty-five years is merely that of the improvements that have been made in the Weston pattern which has developed from the 30-inch belt driven machine to the 48-inch water or electrically driven; the Weston machine was invented in these Islands, and it is worthy of notice that our beet sugar rivals clung to older and less efficient patterns long after the suspended machine was firmly established in nearly all cane growing districts.

Attention should be called to the "syrup classifying" devices which find a use where the masse-cuites are washed with water and with steam in the manufacture of a plantation-refined sugar. The

continuous centrifugal still belongs to the future, though I have been told that a prominent firm of machinists is prepared to put one on the market as soon as the sugar maker can boil a masse-cuite with a perfectly even grain.

Labour Saving Devices.

The growing scarcity of labour and necessity to meet competition have been responsible for much in this direction. Mechanical megass firing, straining of juices, handling of masse-cuites and of the bagged sugars, are now to be found in nearly all factories; the most efficient labour-saving devices are, I think, those employed in the discharge of canes; but the same degree of success has not yet attended the many appliances devised for the loading of the cane; and a satisfactory cane harvester yet remains to be invented.

Agriculture.

On the agricultural side of the industry I propose to say but very little, and shall merely refer to the great increase in tonnage per acre that has taken place during the period under review in these islands, and to less, but still noteworthy, extent in Java. This increase is to be attributed to the rational use of fertilizers and water grouped together in the term "intensive cultivation," and may properly be included as an item of the technical development of the cane sugar industry.

Experimental Station Work.

Systematic experimental station work with the sugar cane has been carried on for more than the last twenty-five years, but the great bulk of the work has been achieved within that period. In the British West Indies the first experimental work of which I have found any record was that on manuring, carried on by Harrison and Bovell, at Dodd's Reformatory, in Barbados, where these gentlemen made their classical observations on the fertility of cane seed (an observation made independently and simultaneously by Soltwedel in Java); since then Harrison has continued his work on cane seedlings and on the manuring of the cane in the Georgetown Botanical Gardens; his resumé of twenty-five years' experimental work in cane manuring contains much valuable data and may well be read in parallel columns with the conclusions deduced by Mr. C. F. Eckart from results obtained in these Islands; similar work of equal value has been done by Mr. Francis Watts and by Mr. J. R. Bovell in other of the British West Indies; the foundation of an Imperial Department of Agriculture in 1897, (which is, however, concerned with tropical agriculture generally) gave a further extension to experimental work, and amongst the results obtained by the department may be mentioned Mr. Lewton-Brain's first successful raising of pedigree hybrid canes.

The Java experimental stations, of which there are three, started work in 1889; of the immense amount of work done there and

published in the "Archief voor der Java Suiker Industrie," I would call attention to that of Geerligs which deals with all phases of sugar manufacture, and would cite as a masterpiece of applied chemistry his researches dealing with the formation of molasses; to that of Krüger, Went, Wakker and Van Breda de Haan on cane diseases; and to that of Kobus on the chemical selection of cane seed, a piece of work which may yet be invaluable if the methods feasible in the experimental station can be applied on the estate scale.

In Louisiana, experimental work under the direction of Dr. Stubbs started in 1885 and is now carried on in connection with the State University; and of great interest and value are the papers published by C. A. Browne, Junr., dealing with the constitution of the sugar cane, to mention only one amongst many memoirs that have come thence. The experimental station at Audubon Park is peculiar in that it maintains a training school specially devoted to the sugar industry, and thence have come either as students or members of the staff many of the most prominent cane sugar chemists.

Experimental work in Guadeloupe was conducted by P. Bonâme as early as 1878, and his results comprising a very detailed study of the agriculture of the cane are to be found in his treatise "Culture de la Canne à Sucre à Guadeloupe."

The experimental station of the Hawaiian Sugar Planters' Association dates from 1895, and since I am a member of the staff of this station I am disinclined to refer to it further.

The island of Mauritius has supported for a number of years a Station Agronomique, devoted chiefly to the sugar industry and presided over by P. Bonâme. Very recently two more stations have come into being, one in Peru under Mr. T. F. Sedgwick, and the other in Cuba under Mr. J. T. Crawley; and from private advices I understand one is in process of formation in the Argentine Republic.

Literature.

As a general rule, the technical status of an industry may be gauged by the amount of literature published in connection with it; the publications from the experimental stations mentioned above make annually a very respectable showing, and in addition there are a number of journals mainly devoted to the sugar cane industry; of these the *International Sugar Journal*, perhaps better known under its old title, the *Sugar Cane*, is the doyen; the thanks of all those interested in the cane sugar industry are, I think, due to the proprietors of this journal for having made accessible in English many of the more important articles appearing in the Java *Archief*. Of the other journals devoted primarily to the cane industry, I should mention the *Louisiana Planter* and the *Hawaiian Planters' Monthly;* the French and German periodicals devoted chiefly to the beet sugar industry also frequently contain articles dealing with the cane; and

amongst these I may mention the *Bulletin de l'Association des Chimistes de Sucrérie et de Distillerie.*

ANALYSIS.

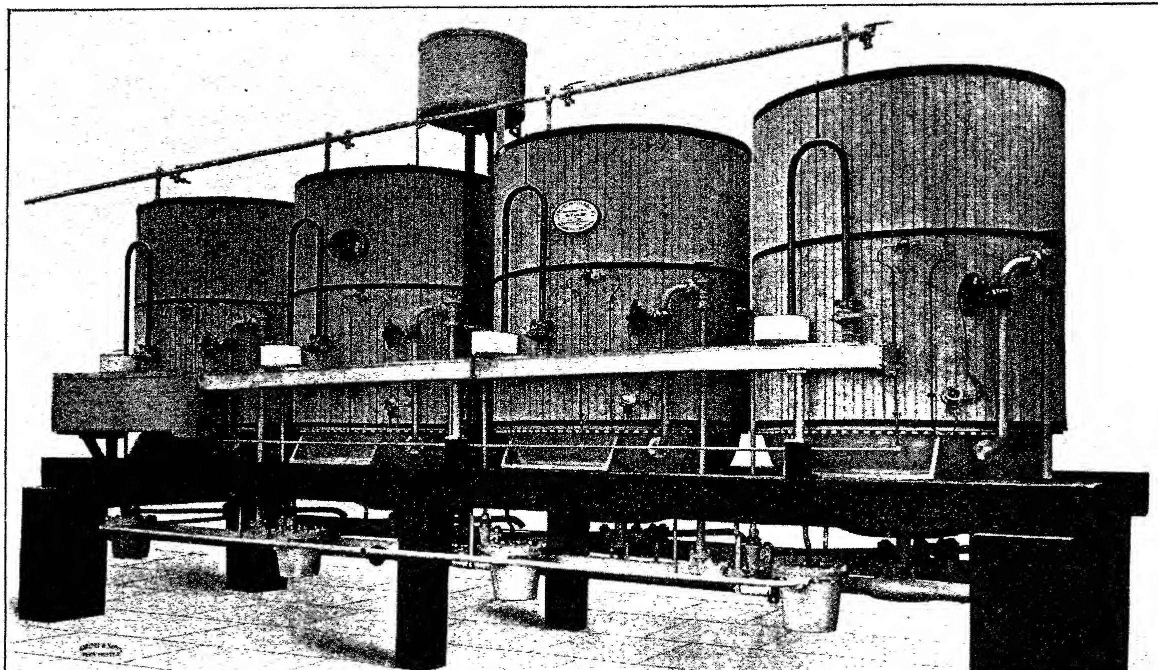
On the subject of sugar analysis alone many folios could be written and I only intend to give one reference to progress in this direction; we are so accustomed to the use of the polariscope that it is hard to believe that but little more than twenty-five years ago this instrument was regarded with disfavour and suspicion. I give some quotations from an article appearing in the *New York Grocer*, and reproduced in the *Sugar Cane* of July, 1879: "The use of the polariscope will make matters infinitely worse, and furnish a vehicle for the safe practice of fraud indiscriminately upon the importer, the buyer and the consumers at the option of operators and their instigators. * * * For instance, the operator adds a few drops more of water than the proper quantity and the grade is lowered; or a few grammes more of sugar than the proper quantity and the grade is raised. * * * Detection is next to impossible."

THE FUTURE.

Great as has been the advance in technical application during the past twenty-five years, much yet remains to be done; a radical advance perhaps not too far removed will occur when the cane factory turns out of itself a refined sugar ready to go into direct consumption; and indeed this is even now done in some factories. It is on the agricultural side, however, I think that most benefit is to be looked for, in increased tonnage, and in canes immune from disease, of higher sugar content and of purer juice; in the study of soil conditions and in the propagation of varieties which will be selected with reference to the soil and climatic conditions of different localities.

The cane sugar industry has often been sneered at as being unprogressive; much of the technical work (in the broadest application of the words) of the last quarter century can be compared with the best that the beet sugar industry has offered; and when we remember that the cane is chiefly grown in isolated districts, far removed from the older centres of learning, that it is in fact a decentralized industry compared with the centralized conditions in Europe, and that it is grown under tropical conditions and often in districts where from malaria and other causes the capacity of the Caucasian for sustained mental effort is necessarily restricted, I think we may say that we have borne our share in the technical development of the production of what is now an essential article of food.

The last few months have seen a trade depression in the Glasgow districts but recent reports suggest that it has passed its ebb, and that an increase in orders for prompt execution is being experienced. This applies to the sugar machinery industry amongst others.



HATTON'S PATENT CONTINUOUS CANE JUICE DEFECATORS.
(800 gallons per hour capacity.)

HATTON'S PATENT CONTINUOUS CANE JUICE DEFECATORS.

Some little time ago we gave in this Journal an illustration and description of Hatton's Patent Continuous Cane Juice Defecators, and we now reproduce on page 430 a photograph of a battery of four of these defecators taken in the shops of Messrs. Fawcett, Preston and Co., Limited, Liverpool, who are the sole licensees for the United Kingdom. The photograph shows these defecators on a temporary staging, as the iron staging upon which they will rest when on the estate was shipped in advance. These defecators have been shipped to Brazil, to which country Messrs. Fawcett, Preston & Co. have since dispatched the necessary parts for the conversion of a number of existing defecators to the "Hatton" system.

The principal features claimed for this system of defecation are that the process goes on continuously, that little more than half the defecator capacity is required to deal with a given quantity of juice, as compared with defecators of the ordinary double-bottom type, that the juice after being limed flows in a constant and steady stream into the defecator in which it is exposed to a temperature of 210° F. (kept constant by an ingenious thermostat or heat regulator which actuates a balanced throttle valve), and flows out of the Defecator clear and perfectly defecated, also that fewer hands are required to work them. The scums resulting from the defecated juice form as they rise in the Defecator a thick layer on the top of the liquid preventing any loss of heat from its surface or inversion by exposure to the atmosphere. These scums are removed from time to time as they collect, and as they only contain a trace of sweet the use of scum filter presses is obviated and the attendant initial expense of these and the recurring expense of new filter cloths is saved.

A considerable number of these defecators are at present at work and giving excellent results. One planter, who has installed a battery of six, writes:—"I am very satisfied with having installed the Hatton continuous defecator system, because it enables me to make the crop with a greater yield in sugar than in former years, better quality of sugar, a larger proportion of first sugars, better class of molasses sugar, less fuel, smaller staff, increased output, and the triple always clean."

Other planters who have installed Hatton defecators on their estates write very much to the same effect.

A company has lately been formed in Turkey with a capital of 1,750,000 frs. to erect and work a beet sugar factory. It is intended to treat 200 tons of beet per day. If, as is stated, the new Turkish Government extends its support to the venture, the latter ought to prove successful.

PRECIPITATION OF LEVULOSE BY BASIC LEAD ACETATE.

By H. C. Prinsen Geerligs, Sugar Expert, Amsterdam.

There still exists some sharp difference of opinion on the question whether levulose is precipitated by basic lead acetate or not, but I believe I have found some reasons for the conflicting results obtained by the various experimentists.

In a recent article under the heading: "The effect of clarification with basic lead acetate on the optical activity and reducing power of sugar solutions"* Messrs. Francis Watts and H. A. Tempany report on experiments which they made concerning the influence of basic lead acetate on invert sugar solutions. They mixed a solution of pure invert sugar in water with a solution of basic lead acetate, and did not perceive any formation of a precipitate, thus shewing that, unlike the conclusions drawn by many other investigators, basic lead acetate does not throw down levulose from the aqueous solution. Now everyone knows that, in fact, levulose does not become precipitated by basic lead acetate from its solution in pure water. This may be seen from a simple experiment and should not give rise to any controversy. But many authors, among whom I reckon myself, presume that when levulose occurs in solution in conbination with salts, the constituents of which latter yield insoluble lead combinations, it will be partly carried over into the lead precipitate, provided that the solution contains so little or no acid that the resulting filtrate is still alkaline. As these conditions will be met with in the clarification with basic lead acetate of well nigh all cane sugar house products, I feel bound to comdemn every clarification with basic acetate in solutions of cane sugar products, yielding an alkaline filtrate, in cases where this filtrate is still to be used for the determination of the reducing sugars.

My opinion is based on the following experiments, which on repetition always gave similar results.

100 grammes of an invert sugar syrup of 70% and 40 grammes of sodium chloride were dissolved in water and filled up to 1 litre. Of this solution portions of 50 c.c. were pipetted into each of a series of 100 c.c. flasks, so that every flask contained 3·5 grammes of invert sugar and 2 grammes of ash, corresponding with the invert sugar and ash contents of 26·048 grammes of a molasses, containing 13·44% of invert sugar and 7·68% of ash.

One of the solutions remained without any addition of lead, while the others were respectively mixed with 10, 25, 35, and 50 c.c. of basic lead acetate, with 25 c.c. of the lead acetate and a drop of acetic acid, and with 25 c.c. of the lead and a drop of soda

* *Jl. Soc. Chem. Ind.*, 1908, 53-58.

solution. The mixtures were filled up to 100 c.c. with water, well shaken, filtered, and the filtrate used for the determination of polarization and reducing sugar with these results. :—

No.	C.c. of Invert Sugar and Salt Solution.	C.c. of Basic Lead Acetate Solution.	Further addition.	Polarization °V.	Reducing Sugars.
					Per cent.
1	50	0	..	— 2·3	3·66
2	50	10	..	— 1·0	3·38
3	50	25	..	— 0·2	3·25
4	50	35	..	+ 0·9	3·20
5	50	50	..	+ 2·5	2·69
6	50	25	Acetic acid	— 1·3	3·35
7	50	25	Soda	+ 0·7	2·88

We see from this table that an increase in the amount of basic lead acetate added to equal portions of salt—containing invert sugar solutions tends to raise the polarization and to reduce the content of invert sugar, so that obviously a levo-rotatory reducing sugar must have been eliminated by the clarification.

A decrease in basicity by adding a drop of acetic acid to the 25 c.c. of lead lowers the polarization from —0·2 to —1·3 and increases the reducing sugar content from 3·25 to 3·35, while on the other hand the addition of a drop of soda brings the polarization up to +0·7 and the reducing sugar down to 2·88. The precipitation of the levo-rotatory sugar is therefore brought along by the basic portion of the sub-acetate. That it is a real precipitation and not a change in the rotatory power of the sugars by the mere presence of the basic lead can easily be demonstrated by shaking the precipitate of Nos. 4 and 5 with water containing a few drops of sulphuric acid, filtering again and polarizing the filtrate, in which case one is sure to obtain a levo-rotatory liquid from a precipitate which was originally filtered off from a dextro-rotating solution. It is necessary to decompose the lead precipitate in an unwashed state, since it is spontaneously decomposed in contact with water and then yields up again its proportion of levo-rotatory reducing sugar. If we choose not to decompose such a precipitate, but keep it on a filter exposed to the air and the light, we shall see after a few days under the uppermost layer, which has been converted into carbonate by the carbonic acid of the atmosphere, the lead precipitate coloured pink, as a consequence of the oxidation of levulose by the lead oxide, which is again a proof of the presence of a levulose plumbate.

Though it is remarkable that basic lead acetate does not cause a precipitate in pure solutions of levulose or of invert sugar, it is apt to throw down the levulose from neutral solutions as soon as they contain simultaneously salts of acids which yield insoluble combinations with lead. This fact is however not without precedents and the chemistry of both organic and inorganic combinations furnishes many other instances of the dragging into reaction of some body when it occurs in the same solution with a kindred one, that would not have shown any reaction if it had not been accompanied by the other one.

Our experiment gives us a good example, for the flask No. 4, containing 35 c.c. of acetate yielded a filtrate, in which further addition of the reagent did not give a new precipitate. The quantity of acetate applied had therefore been sufficient to precipitate all of the chlorine from the solution. This fresh addition of lead, while not precipitating lead chlorine from this filtrate, did not throw down any levulose either, for the liquid remained clear after that addition too. Yet No. 5 in which 50 c.c. of the basic acetate were used yielded on filtration a liquid, containing less reducing sugar and polarizing higher than No. 4 which had only been clarified with 35 c.c. This shows that although 35 c.c. had been sufficient to throw down all the chlorine, those further 15 c.c. had still precipitated more levulose from the liquid in which a precipitate was being formed.

Though it was evident that levulose principally was removed, I thought it important to investigate whether dextrose also was precipitated, and if, when sucrose too was present, this sugar prevented the passing over into the lead precipitate of a part of the levulose.

To this end two solutions were prepared, both containing 70 grammes of invert sugar and 50 grammes of sodium chloride per litre, while one of them was mixed with 100 grammes of sucrose.

No.	c.c. of Basic Lead Acetate Solution.	Further addition.	Series without Sucrose.			Series with Sucrose.	
			Polarization.	Total Reducing Sugar.	Dextrose.	Polarization.	Total Reducing Sugar.
1	1	..	— 3·8	3·63	2·72	20·3	4·96
2	5	..	— 3·2	3·58	..	20·6	4·12
3	10	..	— 3·0	3·52	2·72	21·0	4·08
4	20	..	— 2·1	3·45	..	21·5	4·06
5	30	..	— 1·7	3·39	2·62	22·0	4·11
6	50	..	+ 0·2	2·94	2·54	23·3	4·17
7	20	Acetic acid	— 3·9	3·66	..	20·5	4·87
8	20	Soda	— 1·8	3·40	..	22·4	4·35

50 c.c. of each of the two solutions were pipetted in each of eight 100 c.c. flasks and respectively mixed with different quantities of basic lead acetate solution, one moreover with a drop of acetic acid, and another with a drop of soda solution. Then they were filled up to the 100 c.c. mark, shaken, filtered, and the filtrates used for the determination of the polarization and the reducing sugar. In the filtrates of Nos. 1, 3, 5, and 6 of the series without sucrose the amount of dextrose was determined, too, after Romyn's method with iodine dissolved in a solution of borax.

In the sucrose-containing series the increase of basic lead acetate also occasioned an increase in polarization, which, however, was not proportional to the decrease in the reducing sugar content. This could not be expected, since by the decrease in volume caused by the voluminous lead precipitate the dissolved substances are crowded together in the diminished portion of the solution. The increase in polarization is therefore only partly due to removal of levo-rotating substance, being due also to the huge quantity of insoluble precipitate arising in the heart of the solution. If no levulose was precipitated, the amount of reducing sugar in No. 5 must therefore have been more than in No. 1, where the volume of the precipitate was only small; now it was less, which is a proof that in presence of sucrose and salt levulose is precipitated too by basic lead acetate.

The figures for the dextrose determinations show, that some dextrose has also accompanied the levulose in the precipitate, but this quantity is rather small, as the total decrease in dextrose content is only 0·18 per cent., whereas the total decrease in reducing sugar is 0·69 per cent.

These experiments show clearly that although levulose is not precipitated from its pure aqueous solution by basic lead acetate, this reagent throws down a part of it when it occurs in a neutral solution with other substances which yield insoluble combinations with lead. Since all juices and cane sugar products yield such solutions, every filtrate of such a solution clarified by basic lead acetate will contain some levulose less than the original solution before clarification. Messrs. Watts and Tempany also mentioned a decrease in reducing sugar after clarification, and ascribed this to the removal of a still unknown reducing substance, but I firmly believe this to have been nothing but levulose, which was removed during clarification by the joint action of the lead reagent and salt.

I hope that the above observations will help to bring together the different opinions on this subject, and promote the much to be desired unification of sugar analytical methods.

Though it is perhaps superfluous, I wish to observe here that this paper only treats on the question of the precipitation of levulose, and abstains from discussing the question of the action of the clarification by basic lead on sucrose.

THE DIRECT ESTIMATION OF SUGAR IN CANE AND BAGASSE.

By M. J. Zamaron.

The following apparatus is required for analyses of cane :—

(1.) A cane-cutter* on a small scale, similar to those used in the sugar industry, and capable of cutting up 40, 50, 60, or 100 kilos. of cane in a minimum of time.

(2.) A cast-iron mortar and pestle of special size, to disintegrate the cane cut up by the cane-cutter and so obtain a perfectly homogeneous sample.

(3.) A Zamaron apparatus for the direct estimation of the sugar in the cane.

This last apparatus, which is in use in most cane-sugar laboratories, has been admitted by all specialists in chemistry up to the present day to be most practical, and is specially recommended by H. Pellet, consulting chemical engineer of the Egyptian Sucreries. It is the only apparatus which gives results having a high degree of accuracy.

It is so constructed as to make five analyses at once, and, while avoiding any waste of time, to obtain complete extraction from the thoroughly disintegrated cane, after six washings, with a volume of syrup equivalent to one litre.

Besides the estimation of the sugar, it furthermore enables the percentage of fibre to be ascertained after desiccation.

Taking samples of canes.

In the factories in which the system of diffusion is in use, numerous samples of cane slices have to be taken, so as to obtain, at the end of the day's work, provided the samples are normal, an average exactly representing the quantity of sugar contained in the canes, in order to have as exact an average as possible of the cane worked up in the factory. On the other hand, in the case of factories with the milling system, a large number of canes should be taken for analysis from those going into the mill, or from quantities of canes in bulk, such as waggon-loads, boat-loads, &c.

These samples of canes are to be passed separately to the cane-cutter so as to get slices 2 to 3 millimetres in thickness, which are then crushed in the iron mortar, so as to produce the fineness necessary for analysis.

Preparation of the cane pulp for analysis.

The cane slices coming either from the factory cane-cutter, or from canes cut up in the laboratory by the Gallois cane-cutter, are crushed

* The Gallois cane-cutter is a good example; it consists of a revolving disc fitted with four different knives and can be worked either by hand or by machine.

very finely in the iron mortar, care being taken that they are pounded as fine as possible. In this way a cane-pulp is obtained which mixes perfectly, and lends itself to complete and rapid extraction in the Zamaron apparatus.

This pulp should be got ready as quickly as possible so as to avoid the slightest evaporation of water, which would cause a sensible increase of sugar in the result, and care should be taken that the pulp, as soon as ready, is placed in a receptacle with a lid, and that 100 grammes of the pulp, thoroughly well mixed up, be weighed as speedily as possible. On this being done, the sample is ready for analysis.

Process of complete extraction of sugar contained in the cane.

100 grammes of the crushed and well-mixed pulp are taken and put into the metal box P of the Zamaron apparatus. Then a series of successive extractions with boiling water is carried out. First, 200 cubic centimetres of boiling water (to save time) are poured into the receptacle V of the apparatus which contains the metal box and the pulp; the latter is then boiled for 10 or 12 minutes.

The result of this first boiling is that a tolerably high proportion of the sugar dissolves in the water; and the syrup is drawn off, after the lapse of the above-mentioned time, into a flask A gauged to 1 litre, and into which has previously been poured 10 to 15* cubic centimetres of lead acetate at 28° Baumé for defecation. After extraction of the syrup, the pulp is pressed by means of the little press T in order to separate out as much liquid as possible.

As six successive extractions have to be made in order to extract all the sugar, 200 c.c. of boiling water must a second time be poured on the cane pulp, which will be boiled for the same period as before; the syrup will be drawn off as in the first extraction: and for the four others only 150 c.c. of boiling water need be added†. When the sixth extraction has been completed, there will be a volume of cold liquid of about 950 c.c., which is made up to 1000 c.c. at the temperature of 15° to 20° C. (according to the graduation of temperature employed for the flasks).

This liquid is stirred and then filtered. The filtered liquid is next polarized in a 400 mm. tube. The degrees read multiplied by:—

		Normal Weight. Grms.
·8145	Laurent Saccharimeter	16·29
1·3024	Schmidt & Haensch Saccharimeter	26·048

give directly in grammes the sugar percentage of the canes.

The reducing sugars are determined by the gravimetric method in the same solution which has served for the estimation of the cane

* The amount varies according to the quality of the cane.

† But the same time for heating should be given as in the first two.

sugar, and the result calculated as a percentage of the cane. Extraction having once taken place the pulp is compressed rather strongly in the box by means of the press to extract as much of the water as possible, and is moreover placed in an oven and heated from 100° to 110° C. to dry it completely. Desiccation havng taken place, the fibre percentage in grammes is obtained by two simultaneous weighings. This method is extremely quick and perfectly correct, provided all the above-mentioned points are strictly observed.

Estimation of the sugar in bagasse.

The Zamaron apparatus is likewise used to determine the quantity of sugar remaining in the bagasse after extraction is complete.

An average sample may be obtained by taking a sufficiently large quantity of bagasse, either from the mills or from the diffusion plant, according to the system in vogue.

If the bagasse consists of strips, they must be cut up into little bits with scissors in order to obtain a sufficiently homogeneous mass. Underneath we give the table for the various normal weights, drawn up by M. Léon Pellet* for the various volumes of extraction and for the different saccharimeter tubes:—

Normal Weight.	Total Volume Water of Extraction.	Polarization Tubes. 400 mm.	500 mm.	600 mm.
16·29	1000	81·45	65·16	54·30
16·29	1500	122·17	97·74	81·45
16·29	2000	162·9	130·32	108·6
20	1000	100	80	66·6
20	1500	150	120	100
20	2000	200	160	133·3
26	1000	130	104	86·6
26	1500	195	156	130
26	2000	260	208	173·3

If then we use the normal weight of 16·29 grammes and the 600 mm. tube for polarization, and we have 2 litres of exhausted bagasse, exactly 108·6 grammes of bagasse must be weighed to obtain the percentage of sugar in the bagasse, after polarization of the liquid.

We recommend the following method of determining the amount of sugar in the cane after the juice has been extracted from it by the diffusion method.

Since in practice it is found that the weight of 100 c.c. of juice is equal to 100 grammes of cane, the sugar left in the cane is equal to that in 100 c.c. of the juice. To obtain the juice, the exhausted slices are sent to the laboratory mill, and crushed at least twice. By means of the special Zamaron flask, 200 c.c. of the liquid

* Extracted from the "Vade Mecum de Sucrerie," by L. Pellet and P. Metillon, page 133.

extracted from the slices is taken, and to it is added 10 to 12 c.c. of lead sub-acetate, then 10 c.c. of a solution of common salt (30%), filling up with water to 247 c.c. (for the normal weight of 16·19 grammes) and 244·8 c.c. (for the normal weight of 16·29 grammes), and the whole mixed. Then follows filtration and polarization in a 400 mm. tube. The polarimetric reading obtained, divided by 10, gives the percentage of sugar in the canes. This process gives complete extraction. If, for instance, a polarization of 5·5 be found, the extraction or sugar left in the cane slices will be ·55% of the cane.

Mill Juice.

The method mentioned above is also employed for the juice extracted by the laboratory mills. The polarimetric reading, with 400 mm. tube, divided by 10, gives the sugar per 100 c.c. Figures are found varying from ·20 to ·40. The result should approximate to the extraction found, and should vary in the same proportion as it does.

Determination of the sugar left in bagasse when the cane has been worked by the mill only.

However often the cane has been pressed, it yields sugar, and the estimation of the sugar left can be effected by means of the Zamaron apparatus, proceeding in the same manner as for the analysis of cane, except that instead of taking a weight of 100 grammes, only 50 grammes of bagasse are used. Care is to be taken beforehand that all strips are cut up with scissors in order to obtain a homogeneous sample. These 50 grammes of bagasse undergo extraction by boiling water in the Zamaron apparatus so as to make up a final volume of 1000 c.c., care being taken at the commencement of the operation to add a sufficient quantity of lead acetate. Then the filtered liquid will be polarized in a 400 mm. tube. The result obtained will be the sugar in 50 grammes of bagasse, and multiplying by 2, the sugar in 100 grammes. The calculations to be made are summed up as follows:—

[Normal weight = 16·29 grammes]
Polarization × 0·8145 × 2 = sugar per cent. bagasse.
[Normal weight = 26·048 grammes]
Polarization × 1·3024 × 2 = sugar per cent. bagasse.

Knowing the loss of sugar per cent. of bagasse, the loss in sugar per cent. of cane can then be calculated. To do so, the fibrous residue must be estimated by drying to constant weight the bagasse which after extraction remains in the small box of the apparatus.

Let us assume that there has been found in the bagasse after extraction:—

Sugar per cent.	7·5
Fibre	36·5

and that in the cane an average fibre of 11·50 is found, then the sugar corresponding to 100 gr. of cane will be:—

$$x = \frac{7{\cdot}50 \times 11{\cdot}50}{36{\cdot}50}.$$

Hence $x = 2{\cdot}36$.

Treatment of bagasse by milling and diffusion.

When bagasse has passed through the diffusion process, the sugar in it may be estimated by pressing in the laboratory mill and so expressing the juice, or by treating 50 grammes in the Zamaron apparatus. In the first case, knowing the fibre per cent. of the bagasse and that of the cane, the percentage of loss in the cane may be calculated thus:

Assuming that in the expressed juice 1·70 grammes of sugar per 100 c.c. have been found, and in the bagasse 25% of fibre, then the following calculations will have to be made to obtain the percentage of sugar in the bagasse:

$$\frac{1{\cdot}70 \times 75}{100} = 1{\cdot}275.$$

If 11·50% fibre has been found in the cane, then the sugar lost per cent. of cane will be:

$$\frac{1{\cdot}275 \times 11{\cdot}50}{25} = {\cdot}586.$$

Waste waters.

The sugar is estimated per 100 c.c. in the Zamaron flask, adding the necessary quantities of lead acetate and common salt (30%), bringing up the volume to 244·8 c.c. with water, and then shaking and filtering, and polarizing in a 400 mm. tube. The reading gives directly the sugar per litre. Dividing by 10, the sugar per 100 c.c. is obtained.

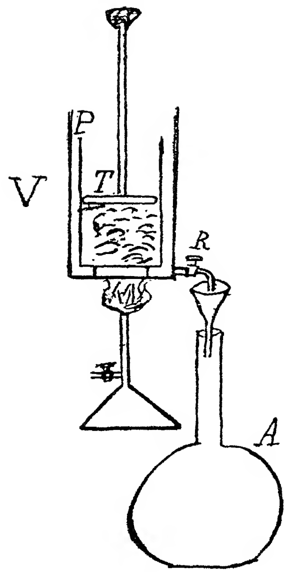
*Description of the Zamaron apparatus constructed by Messrs. Gallois, 37, Rue de Dunkerque, Paris.**

This apparatus consists of five cylindrical receptacles V in copper, provided with little cocks R., and all resting on a metal table which acts as a support.

Each receptacle contains a cylindrical box P of copper, pierced by a number of small holes, and intended to receive the pulp. This box is supported by a small metal tripod stand, to prevent it touching the bottom of the cylinder V.

In each box there is a metal press T, consisting of a rod and a disc pierced with holes. A five-burner Bunsen lamp is suitably placed underneath the receptacles for heating purposes. If gas be not available, a special alcohol lamp can be substituted to give an equally steady heat.

* The other apparatus mentioned in this paper, *e.g.*, cane-cutters, mortars, and flasks, can all be procured from Messrs. Gallois.



Attached to the apparatus is a zinc vessel of sufficient size to contain five flasks A, with a steady flow of water for the purpose of cooling the hot syrup drawn from the recipient V during the process, and bringing the volume to 1000 c.c. as soon as complete extraction has been attained.

ON THE DETERMINATION OF REDUCING SUGARS.

By Percy H. Walker.

Zerban and Naquin* have suggested substituting the Neubaur crucible for the porcelain Gooch with asbestos felt used in Munson and Walker's method for the determination of reducing sugars. The Neubaur crucible appears to be a platinum Gooch provided with a filtering felt of platinum sponge. The authors conclude that the copper should not be weighed as Cu_2O but as CuO and propose a correction of ·0017 gram to be applied to Munson and Walker's tables.

The work of Zerban and Naquin is open to criticism. They did not check determinations by their method with determinations made by Munson and Walker's method on the same invert sugar solutions; but made determinations on an invert sugar solution made by a

* *International Sugar Journal*, **10**, 328-332, (July, 1908).

different method from that followed by Munson and Walker. It may, however, be presumed that the copper determined by weighing as CuO in the Neubaur crucible is correct and that weighing as Cu_2O in this crucible gives high results. This is no evidence however that similar results are obtained when using a porcelain Gooch with asbestos felt. The platinum sponge in the Neubaur crucible would tend to occlude water and other volatile substances, which offers at least one possible explanation of the high results. This error, however, does not occur when using a porcelain Gooch and asbestos felt, as is prescribed in Munson and Walker's method. That weighing as Cu_2O gives accurate results was demonstrated by Munson in checking this method against the electrolytic method as the following table shows*:—

COMPARISON OF THE METHOD OF DIRECT WEIGHING OF CUPROUS OXIDE WITH ELECTROLYTIC METHOD.

Weight of Copper.		Difference in weight.	Weight of Copper.		Difference in weight.
By weighing as Cu_2O.	By Electrolysis		By weighing as Cu_2O.	By Electrolysis.	
Mg.	Mg.	Mg.	Mg.	Mg.	Mg.
440·0	439·6	— 0·4	319·9	320·1	+ 0·2
437·2	437·8	+ ·6	316·7	317·2	+ ·5
227·9	229·1	+ 1·2	317·7	316·5	— 1·2
229·5	230·9	+ 1·4	284·9	284·0	— ·9
447·7	448·0	+ ·3	282·2	281·0	— 1·2
447·3	447·3	0·0	290·0	288·8	— 1·2
320·5	321·4	+ ·9	286·9	286·9	0·0
278·4	278·3	— ·1	287·8	288·0	+ ·2
279·2	280·6	+ 1·4	303·6	303·9	+ ·3
278·0	278·2	+ ·2	303·4	303·3	— ·1
233·6	235·4	+ 1·8	289·5	289·5	0·0
460·4	460·5	+ ·1	298·3	298·8	+ ·5
459·5	460·3	+ ·8	303·2	303·7	+ ·5
316·7	317·2	+ ·5	303·2	302·4	— ·8
312·1	313·4	+ 1·3	Average	....	+ ·22

In investigating the method of weighing as Cu_2O before preparing the tables in question the writer ran a number of determinations by weighing as Cu_2O and then determining copper by Low's Volumetric Method, and obtained results entirely in accord with those previously obtained by Munson by the electrolytic method. It appears from the

* Proc. 19th Am. Con. A.O.A.C. Bur. Chem. Bull. 73, p. 64.

work of Zerban and Naquin that weighing as Cu_2O in a Neubaur crucible gives slightly high results, but weighing as CuO gives correct results. These results therefore should be in accordance with Munson and Walker's tables and no correction should be applied. The disadvantage of weighing as CuO is that it is not so convenient to refer to the copper values of the Munson and Walker tables as to refer to the Cu_2O values.

Contracts Laboratory,
Bureau of Chemistry, Washington.

CALCULATION OF THE PARITY OF DIFFERENT KINDS OF SUGAR.

By H. C. Prinsen Geerligs, Sugar Expert, Amsterdam.

On page 405 of the last number of the *International Sugar Journal* "Sucrose" asks how much sugar of 94 nett polarization can be expected from 50 tons of second and an equal quantity of third sugar, when these are melted, skimmed, and returned into the vacuum pan.

In answering this question, we have to consider that the difference in weight of the sugars melted and of the first sugar recovered from these is due to two different causes. Firstly we lose sucrose as a natural consequence of every manipulation, and secondly a more considerable amount of molasses adhering to the crystals is included in the weight of the low grade sugars than in the case of the first sugar. Therefore, even if the real loss of sucrose is accounted for, we cannot use the simple nor the nett polarization figures as a basis of comparison for the weight of sugar melted and sugar recovered, but we have to see how much crystallized and crystallizable sugar is present in every one of the three assortments under consideration and calculate their parity after these.

In the following calculations we take the sugar to consist of pure crystallized sucrose coated with a layer of exhausted molasses of 32·5 quotient of purity. In reality this is not so, and the adhering molasses is, as a rule, richer and purer; but this has no effect on our calculation, because the sugars are melted, and because we assume he first sugar to leave behind an exhausted molasses of 32·5 quotient. The sucrose which is present in the layer of molasses around the crystals in the second and third sugars, in excess of the amount corresponding with that quotient of 32·5, can crystallize and is therefore incorporated in the figures for crystallized and crystallizable sucrose in the different sugars.

We find the amount of sucrose crystallized and crystallizable on 100 parts of sucrose (polarization) in the different sugars from the

quotients of those sugars and that of the exhausted molasses by using the following well-known formula:—

$$x = 100 \; \frac{Q - 32{\cdot}5}{100 - 32{\cdot}5} \times \frac{100}{Q}$$

in which Q = the quotient of the raw sugar.

The values for x for every one of the quotients of sugar between 69 and 100 are combined in the table given below.

Table for the value of $100 \; \frac{Q - 32{\cdot}5}{100 - 32{\cdot}5} \times \frac{100}{Q}$ *for every quotient between 69 and 100.*

	0	1	2	3	4	5	6	7	8	9
69	78·37	78·48	78·59	78·70	78·80	78·90	79·00	79·10	79·19	79·28
70	79·37	79·47	79·57	79·67	79·77	79·86	79·96	80·05	80·15	80·24
71	80·33	80·43	80·53	80·63	80·73	80·83	80·93	81·02	81·10	81·19
72	81·28	81·38	81·48	81·58	81·68	81·78	81·87	81·96	82·05	82·14
73	82·20	82·30	82·40	82·49	82·58	82·67	82·76	82·85	82·94	83·03
74	83·08	83·17	83·26	83·35	83·44	83·53	83·62	83·71	83·80	83·88
75	83·95	84·04	84·13	84·22	84·31	84·40	84·49	84·58	84·67	84·74
76	84·80	84·88	84·96	85·04	85·12	85·20	85·28	85·37	85·45	85·53
77	85·62	85·70	85·78	85·86	85·94	86·02	86·19	86·18	86·26	86·34
78	86·42	86·50	86·58	86·66	86·74	86·82	86·90	86·97	87·05	87·13
79	87·20	87·28	87·36	87·43	87·51	87·59	87·67	87·74	87·82	87·89
80	87·96	88·03	88·11	88·19	88·27	88·35	88·42	88·49	88·57	88·64
81	88·70	88·77	88·85	88·93	89·00	89·07	89·75	89·22	89·29	89·36
82	89·43	89·50	89·57	89·65	89·72	89·79	89·86	89·93	90·00	90·07
83	90·14	90·21	90·28	90·35	90·42	90·49	90·56	90·62	90·69	90·76
84	90·83	90·90	90·97	91·04	91·11	91·18	91·24	91·30	91·37	91·43
85	91·50	91·57	91·63	91·70	91·77	91·83	91·90	91·97	92·04	92·10
86	92·16	92·23	92·30	92·36	92·43	92·50	92·56	92·62	92·69	92·75
87	92·81	92·88	92·94	93·00	93·07	93·14	93·20	93·25	93·31	93·37
88	93·44	93·50	93·56	93·62	93·68	93·74	93·80	93·87	93·93	93·99
89	94·05	94·11	94·17	94·23	94·29	94·35	94·41	94·47	94·53	94·59
90	94·65	94·71	94·77	94·83	94·89	94·95	95·00	95·06	95·12	95·18
91	95·24	95·30	95·36	95·41	95·47	95·53	95·59	95·64	95·70	95·76
92	95·81	95·87	95·93	95·98	96·04	96·10	96·16	96·21	96·27	96·33
93	96·38	96·44	96·49	96·54	96·60	96·65	96·70	96·76	96·81	96·87
94	96·93	96·99	97·05	97·11	97·17	97·23	97·28	97·33	97·38	97·43
95	97·45	97·51	97·57	97·62	97·67	97·72	97·77	97·82	97·87	97·92
96	97·99	98·05	98·11	98·17	98·23	98·27	98·31	98·36	98·41	98·46
97	98·51	98·56	98·61	98·67	98·71	98·77	98·82	98·87	98·92	98·97
98	99·02	99·07	99·12	99·17	99·22	99·27	99·32	99·37	99·42	99·47
99	99·51	99·56	99·61	99·66	99·71	99·76	99·81	99·86	99·91	99·96

Now coming to "Sucrose's" example we are free to assume the following analysis of his three sugars:—

	First.		Second.		Third.
Polarization	96·70	..	91·90	..	88·50
Glucose..	0·85	..	1·92	..	1·82
Ash	0·37	..	0·85	..	2·10
Moisture	1·04	..	2·00	..	2·50
Undetermined..	1·04	..	3·33	..	5·08
Total	100·	..	100·	..	100·
Nett	94·	..	85·73	..	76·18
Quotient	97·7	..	93·8	..	90·8

Next we may assume a total loss of sucrose during the handling of these low grade products of 4% of the total sucrose, which loss is occasioned by spilling, skimming, boiling over, inversion, caramelizing, &c. This is, of course, not a fixed figure; it may be more and it may be less, but from my experience I can take it as a good average and at any rate suited for this calculation.

Fifty tons of second sugar of 91·9 polarization contain $\frac{50 \times 91·90}{100}$ $= 45·95$ tons of sucrose, which in sugar of a quotient of 93·8 contain after the table $\frac{45·95 \times 96·81}{100} = 44·48$ tons of crystallized and crystallizable sucrose.

Fifty tons of third sugar of 88·50 polarization contain $\frac{50 \times 88·50}{100} =$ 44·25 tons sucrose, which in sugar of a quotient of 90·8 correspond with $\frac{44·25 \times 95·12}{100} = 42·09$ tons of crystallized and crystallizable sugar.

We have melted $44·48 + 42·09 = 86·57$ tons of crystallized and crystallizable sucrose, lose 4% in the course of manufacture and therefore recover in the first sugar $\frac{86·57 \times 96}{100} = 83·11$ crystallized sucrose.

These occur in a sugar of 97·7 quotient and therefore correspond with (according to the table) $\frac{83·11 \times 100}{98·87} = 84·06$ tons of sucrose or with $\frac{84·06 \times 100}{96·7} = 86·92$ tons of first sugar of the required quality of 94 nett.

According to latest advices, the repatriation of the Queensland Kankas is now complete and all the industries of that colony are worked by white men. The Government has been ascertaining the views of some of the immigrants as to their endurance of the tropical conditions and a considerable number of the workers hailing from England have expressed themselves as perfectly satisfied with their lot.

THE CARBONATATION OF BEETROOT JUICES.*

By Eug. Stuyvaert.

(*Continued from page 400.*)

(*c*) *Purifying effect of the calco-carbonic treatment.*

We have seen from our previous study of the calco-carbonic process that there are two distinct classes of bodies contained in the juices; the first of these includes those substances which the lime is capable of rendering insoluble, and which are therefore completely eliminated; the second group comprises those bodies which are not precipitable by lime but which may be transformed in a more or less complete degree into other products. A part therefore, of the non-sugar of the raw juice can be eliminated by the treatment under consideration. The non-sugar which remains includes the alkalis, chlorides, sulphates, the greater part of the nitrogenous matters, and certain organic acids existing as such in the raw juices or acids which have been formed by the action of the lime. It will be concluded from this that the purifying effect of the process with regard to the mineral impurities cannot be much increased beyond a certain limit; the alkalis, chlorides, and sulphates constitute generally more than 60 % of the actual mineral matter of the juice, and after clarification it is but rarely that the elimination surpasses one-third. The elimination of the organic matter depends more than that of the mineral impurities on the quality of the beet, its state of preservation, and on the manner in which the diffusion process has been conducted. The better the quality of the root, the lower will be the nitrogenous bodies contained in it, and the riper it is, the greater will be the proportion of these bodies in the juices existing as albumenoids, which is the most favourable form for their elimination.

The degree of purification that the lime is capable of effecting is partial and variable; it depends not only on the efficacy of the calco-carbonic treatment but largely on the quality of the raw material, so that it may be said, all other conditions being equal, as the beet is, so the quality of the juice will be. But for a given quality of beet, the work of extraction can give a juice purifying more or less readily, just as, all other factors being equal, a more or less rational application of lime is capable of giving juices more or less purified. It is, therefore, not superfluous to repeat that to obtain well clarified juices, it is necessary, firstly, to extract during diffusion as little as possible of the non-sugar, producing as regular a cossette as possible, secondly, to render the work of the pulp eliminators efficient, and lastly, to rapidly reheat the juices, and in doing so to exclude access of air.

* Contribution to the *Manuel de la Fabrication de Sucre de Betteraves*, edited by the Société Technique et Chimique de Sucrerie de Belgique. Translated by special permission.

The only practical method which we have at present for the determination of the purifying effect of the defection and carbonatation processes is that based on the idea of the quotients of purity and impurity. In Belgium the different juices generally possess quotients varying between 84 and 89, and these values are usually raised by the calco-carbonic treatment to 90-94. By means of these figures it is easy to state the total impurities accompanying the sugar in the raw and in the purified juices, and consequently to calculate the elimination of the non-sugar per 100 parts of sugar, or for each 100 parts of non-sugar which has been effected by the purification.

Thus, *e.g.*, in a raw juice of 84 apparent purity there are 100–84 = 16 parts of the apparent non-sugar, and hence in 100 parts there will be $\frac{16 \times 100}{84} = 19$ parts of apparent non-sugar, or $19 \times 0{\cdot}9 = 17{\cdot}1$ parts of actual non-sugar. By applying the same calculation to the co-efficients quoted above, 84 and 89, 90 and 94, we obtain 17·1, 11·2, 10·0, and 5·8 parts of actual non-sugar respectively. In passing from the purity of 84 to one of 90, the juice therefore gives up $17{\cdot}1 - 10{\cdot}0 = 7{\cdot}1$ parts of non-sugar for every 100 parts of sugar. There has thus been an elimination of $\frac{7{\cdot}1 \times 100}{17{\cdot}1} = 41{\cdot}5\%$ of non-sugar; and in passing from 89 to 94 this value becomes $\frac{(11{\cdot}2 - 5{\cdot}8) \times 100}{11{\cdot}2} = 48\%$ of impurities accompanying the sugar in the raw juices.

Generally the figures representing the results of a properly operated purification vary between the limits of 40-48, but often these values are not reached and hardly a third of the non-sugar is eliminated; on the contrary, it is rarely possible to rise to 50 per cent.

It should not be concluded from the above that a true indication of the purification of a juice can be obtained from quantitative results, or that juices having identical quotients of purity necessarily possess this same value from the point of view of the ready crystallization of their sugar. This is certainly not so, for the nature of the non-sugar and the physical properties it communicates to the juices have a considerable influence in this direction. Thus it is that the action of sulphurous acid exercises a favourable action on the crystallization of the sugar without modifying in any apparent degree the co-efficient of purity of the juices, such treatment giving to the liquors a decreased viscosity and consequently a greater facility for crystallization.

IV.—Liming.

Quantity of Lime.—The amount of lime to be used in defecation has no theoretical basis; thus the opinion of operators often varies considerably on this point, and this is not to be wondered at since, in reality, the quantity necessary to give the best effect differs with the quality of the root and the efficiency of the work of extraction. It

must not be forgotten that the action of the lime is not to be considered from a purely chemical point of view, but that it is also necessary to regard its physical effect, which is directly dependent on the quantity added. Raw juices treated with a deficiency of lime are not only badly decolorized, but filter with difficulty because the viscous substances thrown out by heating and defecation are not surrounded by a sufficient quantity of calcium carbonate to readily carry them down on carbonatation.

Generally good results are obtained by working with 2·0–2·5 kilos. of quick-lime for every 100 kilos. of roots operated upon. With roots of inferior quality it is advisable to increase this amount both at the beginning of the campaign when under-ripe roots are worked, and towards the end of the season when altered beets are frequently dealt with. An increase in the amount of lime is generally the solution of problems involving difficulties of purification and filtration; in such cases amounts as high as 3·0–3·5 kilos. per 100 kilos. of roots may be added.

For many years past, sugar technologists have endeavoured by several means, to effect an economy in the amount of lime used in defecation, and this more particularly in countries where the material is not of good quality or is difficult of extraction. If it is true that with an amount of lime, less than 2 kilos. it is possible to obtain well clarified juices, the fact that with such diminished quantities, the work of the filter-presses and the washings of the scums are apt to be rendered less efficient must also be taken into account; by using quantities of lime within the ordinary limits, strong scum cakes which are readily freed from sugar are obtained, but with small quantities of lime the cake is badly formed, and retains a comparatively large amount of sugar.

Form of Lime.—The various forms in which lime has been tried for the defecation of sugar juices are: calcium oxide (quick-lime), in small pieces or in powder; hydrated lime (slaked lime), in powder, in paste, or in the form of milk-of-lime. In the practice of the present day the modes of liming which are most generally used are the wet, or milk-of-lime, and the dry, or quick-lime. When using the first of these the lime is mixed with the juice in the hydrated state in suspension in water, and in the second it is added in the anhydrous condition in small lumps. As soon as the burnt lime in the second method comes in contact with the juices it becomes slaked and an evolution of heat takes place, every kilo. of lime liberating 150 calories of heat on becoming hydrated. Thus, *e.g.*, if 66 hectolitres of juice of 1·05 density are treated with 150 kilos. of anhydrous lime the temperature will rise 3-4°C. Hence it is necessary to pay particular attention to overheating the juice in one place, and to insure that all the volume of the liquor takes part in the hydration of the quick-lime added. Modern defecators, however, are generally

constructed on rational principles, and these will be be discussed later on.

As to the more preferable method of defecation, certain claims are made for both. Some see in the dry mode of working a more exact means of measuring the quantity to be added to the juice, whilst others state measuring is more convenient and preferable and can be carried out with sufficient accuracy in practice by taking a density determination, or by means of special balances. Whichever method be used it is necessary to entrust this important department of the factory to a careful and reliable workman in order to obtain satisfactory results.

Certain objections to the dry mode of liming have been made from time to time by various workers; the principal of these state that the defecated juices are not so well clarified and the sugars obtained are more coloured by this method than by the other. It is most probable that the reason of this stated lesser clarification is to be attributed to the disappearance of a portion of the sugar in the form of calcium sucrate, causing thus a diminution in the ratio of the sugar to the total solid matter of the juice, and consequently giving a lesser purity. Again, certain sugars coming from factories using the dry lime system have sometimes a greyish or reddish coloration; this is due to a defective application of the carbonatation process in which the iron salts have not been precipitated. Other workers state that when efficiently carried out superior clarification and decoloration effects can be obtained by it than by any other.

Dr. Herzfeld has investigated the subject of the relative value of the wet and dry modes of liming, and after an exhaustive study of the question has arrived at the conclusion that he was unable to find any difference of quality between the juices treated by one or the other method. It may, therefore, be admitted that both processes when rationally carried out have the same value as means for the purification of beet juices.

Dry liming has however replaced milk-of-lime working in a large number of factories because it does not necessitate dilution of the juices; the use of the latter dilutes the juices to a certain extent it is true but the advantages of the former material with regards to the economy in steam it effects has been very greatly exaggerated.

Temperature and duration of liming.—It has already been pointed out that the reaction which takes place between the non-sugar of the raw juice and the lime are not instantaneous and that there is a certain limit of time and temperature which must be adhered to in order to give the most efficient defecation. Either the juice and the lime remain in contact for a relatively short time at a temperature of 75-85° C., or else the milk-of-lime and juice are mixed together at the ordinary temperature and allowed to remain in contact with one another during a relatively long period of time, about one hour, then

slowly raised to the temperature of carbonatation say 70-75° C. The former mode of operation may, or may not, be used when working with the wet process of defecation, but when using anhydrous lime it is necessary, because it is only under these conditions that a proper melting of the juices of lime occurs. The latter method of working has, during the past few years, been strongly recommended by several experts. From the point of view of purification proper, *i.e.*, the elimination and transformation of the soluble non-sugar, it can hardly be said that the superiority of either method has been practically demonstrated up to the present time, and it is impossible to show *a priori* that the prolonged reaction, at first in the cold, and afterwards at an increasingly high temperature, eliminates the non-sugar of the juice more completely than by the more rapid treatment at a higher temperature. Comparative trials on the large scale can alone establish the best conditions of working. It is generally considered that by the hot and rapid method of working the eliminable mineral non-sugars and organic acids are completely separated from the juices, and that a long time of contact is unnecessary. It is rather from the standpoint of the more or less transformation of the amides, albumenoids, and invert sugar by the lime that the merits of one or the other mode of working must be judged. It is certain that if liming is carried out in the cold and the time of contact is insufficiently long the full defecating power of the lime is not attained.

In order further to form an opinion as to the superiority of either method, it is necessary to determine which is less liable to cause a re-solution of the precipitated matters in suspension and also of those in the entrained particles of beet pulp, and particularly to show that the solvent action depends more or depends less on the temperature than on the duration or the amount of lime dissolved in the juice.

With regard to the degree of decolorization obtainable, it is generally agreed that cold working gives the best results so far as the juice itself is concerned, but it is not to be concluded from this that this method gives the best ultimate results. The cold process will indeed give lighter juices than when a higher temperature is used because the coloured acids form principally at temperatures above 70° C., but the juices inevitably darken when carried to a higher temperature during subsequent operations, and finally the syrups will be just as coloured as if the raw juice had been treated by the hot method.

When the raw juice is treated to 75-85° C. before the addition of lime a certain amount of the soluble albumenoids are coagulated; further, a large number of organic salts of lime are less soluble at high temperatures. From these two facts it can be said that hot liming is more advantageous with regard to the more complete elimination of the albumenoid matter and lime salts than the other. Moreover, it is our opinion, that from the point of view of the

readiness of separation of the precipitates and the recovery of sugar in the cake, that hot working certainly has the advantage.

It may therefore be concluded that, all things being considered, it is best to operate the defecation at high temperatures, to re-heat the juices to a temperature of 75-85 before adding the lime, and to allow the lime to remain in contact with the juices before turning on the carbonic acid gas, for between ten and fifteen minutes, according to the temperature that has been used.

Dry Liming.—The quantity of lime necessary for defecation may either be weighed or measured; the first method is theoretically the more exact, but in many factories it is preferred to use the latter because the presence of improperly calcined and heavy lumps has less influence. From time to time the accuracy of the volume of lime corresponding to the supposed weight is verified, and a further check is made by determining the total alkalinity of the defecated juice.

The amount of lime considered necessary per hectolitre of the juice varies largely but it may be taken on an average to be 80-75 kilos. The material should be in pieces about the size of one's fist, and should be clean and of good appearance.

To carry out dry lime defecation successfully and well the juices should be sufficiently re-heated before the material is added. Before entering the defecators a temperature of 75-85° C., and with certain qualities of lime as high as 90° C. should be reached; the re-heaters must therefore be constructed to carry their contents to the highest temperature named.

It has already been pointed out that in order to avoid dangerous rises of temperature it is necessary to bring all the volume of the juice in contact with the lime, and this condition can be best fulfilled by allowing the material to come in contact with the juice in a flat layer and by keeping the whole in constant motion. In well-constructed defecation tanks the lime is placed in a metallic basket to which is given a slow movement, generally circular, while the juice is kept agitated by stirrers provided with arms above and below the basket; they should further have some means for the ready emptying out of stones, grits, and half-burnt particles of lime from the basket. In working the lime must be uniformly spread out so as to cover the greatest possible surface and thus give it the best opportunity of coming in contact with the greatest volume of juice.

Under normal conditions of working, the lime passes completely into the juices at the end of about 15 minutes, but when dealing with dead or badly calcined lime the operation is very much slower. The dry method of liming, therefore, demands a good quality of limestone and a careful management of the kiln.

Wet Liming. Determination of the Volume of the Milk-of-Lime.—The milk-of-lime should be of a uniform density throughout; its

preparation should be carefully controlled, and any important fluctuation in its density taken account of, and a corresponding allowance made in the volume added to the defecator. It is thus necessary to entrust its measurement to an intelligent and careful workman.

The carrying out of the work of measuring the volume of the milk-of-lime by taking its density is a simple matter; it is only necessary to have a cylindrical reservoir provided with a scale indicating the different volumes of the liquid used. This volume depends on its density, which is generally expressed in degrees of the Baumé scale. There are certain automatic measurers for this purpose which, for a liming of a certain percentage for which the apparatus is regulated, automatically, in proportion to its density, vary the volume which must be admitted into a measurer. Generally with these it is possible to lime with a variable percentage within certain limits to which they are adjusted.

Preparation of the Milk.—The milk-of-lime for defecation may be prepared in several different ways. Formerly it was prepared by hand, but at the present day, except in some of the smaller factories, it is general to use mechanical appliances of various designs.

One of the best of these is the "Mik" apparatus. It consists of a long drum revolving on rollers. Through a hopper attached to one extremity of the drum the lime is introduced, and a little lower down the water enters. The drum on the inside is provided with projecting surfaces which throw up the lime, allowing it to fall back into the circulating water which passes out at the other end of the apparatus. The unslaked material is held back by receptacles. By the use of this appliance a milk-of-lime of high density can be prepared but usually it is preferred not to exceed a density of 24° Bé.

For the slaking of the lime the sweet-waters from the filter presses may be used. It is often stated that the sugar contained in the sweet-water is liable to destruction by reason of the high temperature resulting from the slaking of the lime. In support of this opinion it is pointed out that the water acquired a yellowish-brown colour, and that this is due to the presence of caramel produced by the action of the alkali at a high temperature; this coloration, however, is very often produced solely by the presence of soluble iron compounds.

Without doubt, if proper precautions are not taken, it is possible to produce a dangerous increase of temperature. It is easy to show that when slaking is carried out in a rational manner there is no danger of attaining a temperature sufficient to attack the sugar. Thus, using 23 kilos. of pure lime per hecto. of sweet-water, the heat liberated by hydration will be (23×150) 3450 calories; this is absorbed by 100 kilos. of water, giving an increase of temperature of about 35° C., and if the sweet-water is heated to 50-60° C., the resulting temperature

is below 100° C., and far from the temperature at which sugar is caramelized. But for the heating to be general and uniform, we point out again, it is necessary to operate so that all the volume of the water partakes in the hydration.

To slake the lime, and prepare the milk, it is possible to operate in two different ways: either the total quantity of quick-lime is introduced into a tank, water sufficient for its hydration sparged over it, and finally a quantity of the sweet-water necessary to bring it to the desired gravity added; or to the sweet-water, pieces of the quick-lime may gradually be added, and the whole well agitated after each successive addition. In certain milk-of-lime preparers, notably in the "Mik" the quick-lime and sweet-water are introduced at the same time; for a proper working it is only necessary to avoid adding too much quick-lime in proportion to the water, and to make the supply of both regular and continuous. It is well to use warm water; with cold water the lime in suspension is generally found to be in an insufficient state of sub-division. When the supply of sweet-waters is insufficient it is preferable to complete the quantity by using condensation water of which there is always plenty in the factory; some use weak juice to bring the dense milk-of-lime up to the desired gravity.

It has been proposed to wash the slaked lime before use by allowing the first milk to settle and to draw off the clear supernatent liquor thus obtained. The supposition is that all soluble salts are thus extracted, but further than this operation wasting a considerable amount of material, and the extraction only being partial, the very small amount of soluble matter usually present hardly justifies the trouble and the diminution in the strength of the liquor caused by its exposure to the air.

Irregularities of Defecation.—It sometimes happens that the lime slakes very slowly. In the case of dry liming, this may be due to an insufficient re-heating of the juices, or it may be due to the lime having been too strongly burnt, or again it might be caused by the presence of certain impurities in the limestone. To remedy this the juices should be more strongly reheated, or warmer water should be used for the preparation of the milk-of-lime. When lime which "melts" difficultly is being used it should be lightly watered a little time previous to mixing.

In order to avoid these irregularities in the condition of the lime, attention must be paid to the work of the kiln, with special regard to charging and the management of the gas-pump.

(*To be continued.*)

France.

Dunkirk.—The total quantity of sugar exported to all countries in 1907 was about 108,000 metric tons, the bulk of which, some 100,000 metric tons, was taken by the United Kingdom. The exportation to the United Kingdom therefore shows an increase compared with 1906 of 32,000 odd metric tons. The figures for the last five years point to a steady increase in the importance of this trade with the United Kingdom. It is true that in 1906 there was a decrease in the quantity compared with 1905, but that is probably to be accounted for by the shortage in the crop indicated in that year's report.

Exports of Sugar from Dunkirk, 1905-07.

	Average, five years ending 1906.	1905.	1906.	1907.	Destination.
Sugar, raw	68,258	83,270	72,137	104,762	Great Britain, 98,003 tons; Ireland, 2,953 tons; Uruguay, 1,200 tons; Denmark, 1,168 tons; Argentina, 840 tons; Netherlands, 395 tons; French colonies.
Refined	4,252	4,218	3,495	4,126	Algeria, 2,963 tons; Tunis, 1,065 tons; United Kingdom, 81 tons; French colonies, ships' stores.

Norway.

The British Consul-General in reporting on the Norwegian Budget for the year 1908-09 states:—

Under the Ordinary Budget the estimates provided for a revenue of £6,972,222 and an expenditure of £6,958,333, giving a surplus of £13,889. The margin is certainly not a large one, but the Government have felt justified in proposing and making provision in the estimates for the reduction in the duty on sugar of 5 ore (about ½d.) per kilo., from January 1st, 1909, the present duty on common sugar being 30 ore per kilo. (about 2d. per lb. British). This is practically the only change in the whole of the estimates calling for special notice. In consequence of this reduction the Minister of Finance calculates the revenue to be derived from the customs at £41,666 less than would have been the case if the sugar duty had been maintained at the present rate. Taking this reduction into consideration the Budget really shows an excess of revenue over expenditure of about £55,555.

China.

Hankow.—The apparent advance in native brown and white sugar at the expense of the foreign indicates that Kuangtung sugars were sent from Chinese ports instead of viâ Hong-Kong, but higher exchange may also have checked foreign arrivals, the bulk of which are from Java and Manila. No Szechuen sugar came here and very little beet sugar from Germany, while Japanese refined decreased some 4600 bags (say 650,000 lbs.). Hunan, Ichang, and other interior

markets took 60 per cent. less of all sorts than in 1906. Hong-Kong refined sugar and Hong-Kong and Swatow brown and white all rose slightly in price during the year, and the first named improved so much in appearance and value as to check competition from Japan. The import of cube sugar is put at 100 cases only.

IMPORTS OF SUGAR INTO HANKOW DURING 1906-07.

	1906.		1907.	
	Cwts.	£	Cwts.	£
Refined	283,216 ..	201,647 ..	287,069 ..	207,492
	Lbs.		Lbs.	
Brown, white, candy....	61,628,800 ..	273,919 ..	42,131,867 ..	233,210

FOREIGN IMPORTS INTO HANKOW, AVERAGE FOR FIVE YEARS 1901-05.

	Cwts.	£
Sugar	333,270	196,574

JAPAN.

Imports of sugar.—The 1907 imports of sugar showed a reduction of nearly £400,000 as compared with 1906, the decline taking place in both raw cane sugar from Java and in German and Austro-Hungarian beet sugar. The following tables gives the principal countries participating in the trade during the past three years:—

	1907.	1906.	1905.
	£	£	£
Dutch Indies	1,703,700 ..	2,040,600 ..	1,212,600
Philippine Islands....	124,300 ..	43,300 ..	29,200
Germany	48,800 ..	124,300 ..	31,000
Austria-Hungary	24,800 ..	43,500 ..	600
Hong-Kong..	36,500 ..	30,000 ..	62,800
China	32,700 ..	47,700 ..	52,900
Other countries	57,100 ..	92,500 ..	10,100
Total	£2,027,900	£2,421,900	£1,399,200

The only country to make any considerable advance was the Philippine Islands. As stated under the heading of exports, the question of Formosa must never be lost sight of in discussing the Japanese sugar industry.

Towards the end of 1907 it became fairly evident that an increase in sugar taxation in the near future was inevitable, and consequently large orders were placed in the hope that the sugar would arrive before the new duties could be imposed.

Although this report deals with 1907, it will not be out of place to state here that the Government, realising that the object of their increased taxation Bill would be defeated if the anticipatory importations were allowed to assume too great dimensions, hurried their measure through Parliament, with the result that the new Sugar Consumption Tax Law was promulgated on February 22nd, 1908, and came into force at once.

The consequence was that large quantities of sugar just arrived too late to benefit by the old rates.

The new rates are now as follows; the old are inserted for the sake of comparison:—

	Per 100 Kin.	
	Old Consumption Tax, including Extraordinary Special Tax.	New Consumption Tax.
	Yen sen.	Yen sen.
First class sugar, below Dutch standard No. 8, and molasses	2 00	3 00
Second class sugar, from Dutch standard No. 8, but below No. 15..	4 40	5 50
Third class sugar, from Dutch standard No. 15 to No. 20, and syrup	6 50	8 50
Fourth class sugar, above Dutch standard No. 20, and rock candy	7 50	10 00

Changes in general tariff.—In order to preserve a balance between the general tariff on goods into the composition of which sugar enters and the new sugar consumption tax, a change was also made in the following tariff numbers; the enhanced duty will come into force on September 1st, 1908:—

Tariff No.	Articles.	Per 100 Kin.	
		Increased Rate of duty.	Present Duty.
		Per cent.	Per cent.
50	Fruit juice (sugared) and syrup..	60*	45*
		Yen sen.	Yen sen.
51	Grape sugar, malt sugar, and the like....	9 25	7 25
		Per cent.	Per cent.
53	Honey	60*	50*
		Yen sen.	Yen sen.
55	Confectioneries, fancy biscuits, and other cakes†	26 00	20 00
56	Jam, fruit jelly, and the like†	17 00	13 00
57	Vegetables and fruits preserved with sugar, molasses, syrup, or honey†	10 50	8 00

Export of refined sugar.—No single commodity amongst those enumerated shows such an alarming decrease as refined sugar.

* *Ad valorem.* † Including the weight of the receptacles.

The industry of sugar refining is of comparatively recent growth in Japan, and it is only within the last three years that there was any surplus for export, but in 1906 the amount sent to China and Corea exceeded £1,000,000, and great hopes were entertained as regards this branch of export. Last year, however, instead of £1,000,000 worth China took sugar only valued at £172,000; this was principally due to the action of the Hong-Kong sugar refineries, who sold their product in China at prices with which the Japanese could not compete. There is no doubt, however, that the Japanese sugar industry is a highly promising one, provided that it is not killed by excessive consumption taxes, or upset by the speculative element introduced through fears and anticipations of a Government monopoly.

At present the bulk of the raw sugar imported comes from Java, but in time it is hoped that Formosa will be able to supply most of the mother country's needs.

In the past the output of Formosan sugar amounted roughly to 40,000 tons, while in 1906 the crop was over 77,000 tons, and although in 1907 the weather was unfavourable the amount produced exceeded 62,000 tons.

The Formosan authorities expect that the area under sugar cultivation will in the future be almost doubled, and with more attention paid to fertilizing and ploughing it is hoped that the yield per acre will also largely increase.

Representatives of various interests have visited the island, with the result that apart from Glasgow sugar machinery in the mills, there are also British steam boilers and one set of Leeds steam ploughs at work. The satisfactory results obtained will probably lead to further orders.

Advice to British Merchants.—British merchants should not fail to notice that the quickest way to mail their letters to Japan is viâ Siberia. The Canadian service is almost as fast, but cannot compare with the other in frequency; merchants should therefore make a point of obtaining the latest information on this subject from the nearest post office.

Furthermore, inquiries are often received from manufacturers and merchants at home who merely ask for the names of the principal firms handling certain lines of goods in Japan. Except in cases where any special information is required it would save a good deal of time if the said manufacturers and merchants would apply to the Commercial Intelligence Branch for the names of the leading British firms in Japan. Most of them have offices in London, and business might be arranged immediately to the advantage of both parties. Otherwise two or three months must elapse before the firms are placed in communication with each other.

Society Islands.

Sugar.—There are now two small sugar cane plantations in Tahiti, the mills of which are equipped to manufacture all the raw sugar required for local consumption, which ranges between 400 to 450 tons per annum, according to the degree of prosperity in the other branches of local industries. Not only, therefore, will the importation of raw sugar from New Zealand become unlikely in future, but the quantity of refined sugar from France and the United States will also probably decline through local over-production of raw sugar and the reduction in price which will be the inevitable consequence of this over-production.

PUBLICATIONS RECEIVED.

Sugar Machinery: a Descriptive Treatise Devoted to the Machinery and Apparatus Used in the Manufacture of Cane and Beet Sugars. By A. J. Wallis-Tayler, Assoc.M.Inst.C.E. Second Edition enlarged and extensively revised. 56 illustrations. Crown 8vo., 369 pp. 5s. net. London: William Ryder & Son, Ltd., Aldersgate Street, E.C.

We have long wanted a comprehensive work dealing with the mechanical side of sugar manufacture, which will not only describe to us the best machinery to use but also tell us how to use it. *Chemical* manuals and treatises abound, and have done much to further the progress of the industry; but since Lock & Newlands' large work became out of date, we have had to be content with pickings out of the technical papers or chapters tacked on to books written mainly for the chemist. When therefore Mr. Wallis-Tayler publishes an "extensively revised" edition of his work, "Sugar Machinery," we are anxious to see whether he has at all supplied the omission; but the result of our investigations in its pages occasions a feeling of profound disappointment. The much to be desired work has still to be produced.

Mr. Wallis-Tayler tells us that since the publication of the first edition the many improvements have necessitated the finding room for a considerable amount of fresh matter and deleting descriptions and illustrations of obsolete machinery, But, unless he intended his revised edition to treat on the historical side of his subject, he had far better have made a clean sweep of much that he has retained, and so give us more information on machinery that is really representative and up-to-date. As it is, there is much to complain about. We find mention of machines and makers that are but vaguely known to the

present generation; while several widely known present-day firms are not mentioned at all. Processes are described without any indication that they have long been discarded, *e.g.*, Fryer's concretor, or that they have not yet been established as a practical success, *e.g.*, the short chapter on electrical processes. It was surely unnecessary to tell us that windmills were once extensively employed for driving cane mills and to set forth the objections to them. One would have thought that this motive power was too long out of date to be worth recording. We note the Mirrlees Watson Company are still referred to under their old name of Mirrlees, Watson & Yaryan. In the chapter on curing, no mention is made of Messrs. Pott, Cassels & Williamson as makers of centrifugals nor of their well-known designs; while the list of makers of such machinery includes a name which has long since ceased to be known as that of a leading maker. Nor do we find any reference to Watson, Laidlaw & Co.'s extensively used water-driven centrifugals, and crystallization in motion finds no place in its pages. Finally, we are still told that "fresh canes contain from 17 to 20% of crystalline sugar," a statement we criticised when reviewing the first edition of the book.

The fact is, one is forced to the conclusion that this is a book by an engineer who, whatever his original connection with the sugar industry, has long ceased to be *au fait* with the details of its progress; but having the pen of a ready writer (as his manuals on tea and ice machinery, refrigeration and lubrication show) he has drawn extensively on such sources of information as he was able to lay hands on, without being able to judge very accurately the wheat from the chaff. We regret he did not pursue his studies further before attempting this revision of his earlier work.

But while we consider the book a frank disappointment, we must add that it may prove useful within certain limits for those who want to get some idea of the nature of sugar machinery. There is reproduced in its pages Mr. J. N. S. Williams' well-known paper on "Practice in the Design, Construction, and Operation of Raw Cane Sugar Factories in the Hawaiian Islands," read before the Institute of Mechanical Engineers in November, 1907, which is now out of print, if we mistake not. The description in the chapter on cane mills of various methods of mounting the rollers will prove useful for reference and the chapter on transport of canes, if not very comprehensive, contains some useful data. There is also a chapter devoted to repairs and renewals. In the Appendix we have a number of charts and tables; but the "Technology of Sucrose" and the list of periodicals is still out of date. Deerr's "Sugar and the Sugar Cane" is not included; this *Journal* is still quoted under its old name; and our contemporary "The American Sugar Industry" finds no place at all in the list.

HANDBOEK TEN DIENSTE VAN DE SUIKERRIET-CULTUUR EN DE RIETSUIKER-FABRICAGE OP JAVA. EERSTE DEEL: METHODEN VAN ONDERZOEK BIJ DE JAVA RIETSUIKER-INDUSTRIE. By H. A. P. M. Tervooren. Second Edition. Amsterdam: J. H. de Bussy.

A second edition of this well-known Dutch work, which has been enlarged by the addition of some later information on methods of analysis, including that of molascuit, asbestos, lead, hydrosulphites, ultramarine, and sulphur; and several chapters have been lengthened by the inclusion of further details.

DIE ZUCKERFABRICATION. By Dr. H. Claassen. Third Edition, revised and enlarged. Schallehn & Wollbrück, Magdeburg. Price, Mks. 15.

Dr. Claassen has lately issued a third edition of his useful work on the manufacture of beet sugar, in which he has brought the subject matter down to date by the inclusion of additional information and the revision of previous chapters. A smaller type is used to avoid a too bulky volume, but the change is an advantage, as the new type is more pleasing to the eye.

NEW BOOKS.

CALCIUM CYANAMIDE ALS DÜNGEMITTEL. Prof. H. Immendorf and Kempski. Eugen Ulmer, Stuttgart.

STAMMER'S TASCHENKALENDER FÜR ZUCKERFABRIKANTEN. 1908-1909. Completely rewritten by R. Frühling & G. Henseling.

PASCHENBUCH DER MICROSKOPISCHEN TECKNIK. Sixth Edition. M. 5·80. R. Oldenburg, München.

SOILS AND FERTILIZERS. H. Snyder. Third Edition. Macmillan, New York.

DER BETRIEBSCHEMIKER. Dr. R. Dierbach. Second Edition enlarged. Price, M. 8. Julius Springer, Berlin.

On the 6th August last an Order in Council was issued cancelling previous Orders which had prevented bounty-fed sugar from entering any port of the United Kingdom. This new Order is in accordance with the decision of the Government not to impose any restrictions on sugars entering this country from any foreign state, whether they are bountied or not. The consequence is that from September 1st, sugar is free to enter the United Kingdom, whatever be the source of its origin.

ABSTRACTS, SCIENTIFIC AND TECHNICAL.*

Bang's Method for the Determination of Sugar. *H. Jessen-Hansen. Biochem. Zeitsch., 1908, 10, 249-257.*

The method depends on the fact that cuprous oxide is thrown out, as cuprous thiocyanate, from a solution containing potassium thiocyanate and alkali carbonates, provided no fixed caustic alkali be present. Bang then determines the remaining unreduced copper by means of standard hydroxylamine solution.

To prepare the copper solution (Soldadini's solution), 250 grms. of potassium carbonate, 50 grms. of potassium bi-carbonate, and 200 grms. of potassium thiocyanate are dissolved in 600 c.c. of water at a temperature of 50—60° C.; after cooling the liquid to 30° C., 12·5 grms. of recrystallized cupric sulphate dissolved in 75 c.c. of water is added; the resulting solution is allowed to stand for 24 hours, then filtered, and finally made up to 1 litre. The hydroxylamine solution contains 6·55 grms. of hydroxylamine sulphate, and 200 grms. of potassium thiocyanate dissolved in 2 litres of water.

10 c.c. of the sugar solution are mixed with 50 c.c. of the copper solution, and the liquid boiled for 3 minutes; it is then rapidly cooled and titrated with the hydroxylamine solution until colourless. 50 c.c. of the copper solution correspond to about 60 mgms. of sugar.

The author of the present paper has critically examined this method. He finds that to obtain good results it is necessary to carefully observe each condition prescribed by Bang. Thus, in preparing the copper solution the limits of temperature given must be adhered to, and the liquids must be of the concentrations named. The rate at which the hydroxylamine solution is added should be 20 c.c. in 15 seconds; the temperature and volume of the liquid during titration have also some influence on the results, and therefore determinations must be carried out under strictly comparative conditions.

It is concluded that this method is the most convenient for the determination of sugar; it is sufficiently accurate for ordinary technical determinations, and is particularly convenient for comparative estimations; if, however, greater accuracy be desired, the Kjeldahl modification of Fehling's method should be employed.

Test for Sugar in Condensation Waters, &c. *E. Pozzi-Escot. Bull. Assoc. Chim. Sucr. et Dist., 1908, 25, 1087.*

The following is given as a simple and delicate test for the presence of a carbohydrate in solution: 2—6 c.c. of the condensation water or other liquid under examination are introduced into a test-tube; 5–10

c.c. of conc. sulphuric acid are cautiously poured down the side of the inclined tube so that the acid sinks to the bottom without mixing with the liquid. If a carbohydrate be present a ring, rose-coloured below and light-yellow above, will be formed at the junction of the two liquids.

This test is particularly delicate for cane sugar, and it is stated that so small a quantity as 0·00005 grm. can be recognised by it.

DECOLORIZATION OF MOLASSES FOR POLARIZATION. *C. Grabowski. Centr. Zuckerind. 1908, 16, 969.*

The author confirms the statements of Znew and Maslow that zinc dust is without action on the invert sugar when used in moderate amount for the decolorization of dark molasses in invert polarizations; he shows, however, that when used in excess it is capable of forming levo-rotatory compounds with the non-sugar substance, and for this reason not more than 1 grm. of zinc dust per 100 c.c. of liquid (containing 13·0 grm. of molasses) should be employed.

He recommends the following method of procedure: 52·0 grms. of molasses are weighed out, and made up to 200 c.c.; 10 grms. of mercury and 10 grms. of mercuric oxide are added, and the liquid filtered; 100 c.c. of the filtrate (= 26·0 grms. molasses) are acidulated with acetic acid and inverted by Herzfeld's method; finally 0·5-1·0 grm. of zinc dust is added and the solution polarized.

In using the decolorizing reagent of Nowakowski, $Hg_2 (NO_3)_2 H_2O$, an error is introduced owing to the salt containing a molecule of water; it is usually used in the proportion of 6–10 grms. to 26 grms. of molasses, and a correction of 0·034 c.c. to each grm. added should then be made.

SEPARATION OF CANE SUGAR FROM SEEDS. *E. Schülze. Zeit. Physiol. Chem., 1908, 52, 404;* through *Wochensch. Brau., 1908, 25, 371.*

In a previous paper the author described his method for the identification of cane sugar in seeds as follows: The finely divided seeds are first freed from fat by means of ether, then extracted with boiling 90-92 % alcohol. The sugar in the alcoholic solution is precipitated by strontia and the insoluble compound, which contains carbohydrates other than cane sugar, decomposed by carbon dioxide. After filtration the liquid is evaporated, and the resulting syrup treated with 95% alcohol. The cane sugar is then allowed to crystallize out from solution by slow evaporation over sulphuric acid.

In order to effect as completely as possible the separation of the cane sugar from the other carbo-hydrates, the author now recommends the extraction of the seeds with absolute alcohol at 50° C.; from this extract the cane sugar may usually be crystallized without

using the strontia process. Although cane sugar, it is pointed out, is but sparingly soluble in absolute alchohol, its solubility is considerably increased by the presence of other substances contained in the seeds, and under these circumstances the greater part of it goes into solution.

COLOUR AND SPECTRUM REACTIONS OF SUGARS. *B. Tollens and F. Rovive. Berichte, 1908, 41, 1783-1788.*

The characteristic colour and spectral reactions of various sugars with napthoresorcinol in the presence of hydrochloric acid have been examined by the authors.

Their method of conducting the test is as follows: A small quantity of the sugar, about the same amount of napthoresorcinol, and 10 c.c. of a mixture of equal parts of 1·19 sp. gr. hydrochloric acid and water are boiled in a test-tube for 1-3 minutes; after having stood for 3-5 minutes the tube is cooled, its contents filtered, and the residue washed with water until the wash-waters are colourless. Alcohol (95° Tr.) is then poured on the filter, and the solution passing through examined spectroscopically.

Working in this way the following reactions were obtained: levulose and sorbose, fine red colours, somewhat more violet than that given by resorcinol and levulose; dextrose, mannose, and substances which on hydrolysis yield these sugars, reddish colorations with slight green fluorescence, showing a band in the green portion of the spectrum; galactose and galactosides in absence of levulose (which, if present may be destroyed by heating with dilute (1 : 1) hydrochloric acid), absorption bands in the green and one on the D-line; pentoses, and particularly methyl pentoses, a strong fluorescence; methyl pentoses, violet-blue coloured solutions, with a band on the D-line and also one in the green portion of the spectrum.

HYDROLYSIS OF RAFFINOSE BY ACIDS AND ENZYMES. *H. E. Armstrong and W. H. Glover. Proc. Roy. Soc., Series B., Vol. 80, 312-321.*

Raffinose is readily hydrolysed by acids at ordinary temperatures, the products being levulose and melibiose. It is shown that raffinose is hydrolysed at a rate about one-fifth less than that of cane sugar. The acids nitric, hydrochloric, and sulphuric, differ in their activity as hydrolysts; the ratio of the rate of hydrolysis of both sugars are about the same for nitric acid and for hydrochloric acid, but towards raffinose sulphuric acid is less active. Investigating the hydrolysis of cane sugar and raffinose by invertase, it was found that the enzyme hydrolyst was far less active towards the cane sugar section of raffinose than towards cane sugar itself, being at least five times as active towards the latter.

Inversion of Cane Sugar by Invertase. *C. S. Hudson. Jl. Amer. Chem. Soc., 1908, 30, 1160-1166.*

It is generally stated that the inversion of cane sugar by invertase is not a unimolecular reaction, as when an acid hydrolyst is employed, but follows a totally different law. The author confirms the view of O'Sullivan and Tompson that this conclusion is incorrect, for the reason that there is a source of systematic error in all the polarimetric measurements that have been made. The dextrose formed by the action of invertase on cane sugar is initially the birotatory state, and therefore the optical activity of a solution undergoing hydrolysis is no guide as to the real amount of inversion that has taken place. This source of error can be removed if, to the solution undergoing inversion, caustic alkali be added before taking the polarimetric reading. It is shown that when this is done, the rate of inversion follows the unimolecular order.

In the case of the inversion of cane sugar by acids, observations can be directly made in the polarimeter without taking into consideration the mutarotation of the invert sugar formed. The reason of this is that the acids are strong catalyzers of the mutarotation of invert sugar, and their presence in the solution cause the mutarotation to be completed so quickly that the invert sugar has during the inversion always practically its normal rotatory power. Meyer has recently stated that during the inversion of cane sugar by acids incorrect polarimetric values of the course of the reaction are given during its early stages owing to the mutarotation of the invert sugar. It is shown that these supposed irregularities are much less than the errors of measurement, and that Meyer's results gave no indication of irregularity when they are properly interpreted.

Inverting Power of Sodium Hydrosulphite. *Nowakowski and Muszynski. Gazeta Cukrownicza, 1908, No. 15;* through *Bull. Assoc. Chim. Sucr. et Dist., 1908, 25, 1087-1090.*

The following conclusions are drawn:—

1. Freshly prepared sodium hydrosulphite has a greater inverting power than that which has kept for some time.

2. Sodium hydrosulphite is capable of hydrolyzing cane sugar, but its action in this respect is less than that of sulphurous acid.

3. The sulphurous acid liberated from the hydrosulphite possesses a weaker inverting action than the same amount of sulphurous acid in the absence of hydrosulphite; this is in agreement with Spohr's experiments showing that the presence of neutral salts diminish the inverting power of weak acids.

4. The quantity of sugar which is inverted by the action of sodium hydrosulphite is in direct proportion to the quantity of the salt added up to a certain limit, beyond which a decrease and finally a continued increase is observed.

5. Sodium hydrosulphite does not invert the sugar of the juice from the third carbonatation nor the masse-cuite molasses, even when added in relatively large quantities.

USE OF PHENOL-PHTHALEIN AS INDICATOR FOR THE TITRATION OF ACIDS IN THE PRESENCE OF SULPHUROUS ACID. *E. Pozzi-Escot. Bull. Assoc. Chim. Sucr. et Dist., 1908, 25, 941-944.*

It has been stated by certain observers that phenol-phthalein cannot be used as an indicator for the titration of acids in the presence of sulphurous acid. The author has carried out several experiments in which he shows that the titre of a sulphuric acid solution, and that of the same solution after the addition of varying amounts of normal sodium sulphite, are the same. Phenol-phthalein he finds is reduced with difficulty by sulphurous acid, and is capable of giving reliable results as an indicator in the presence of even large amounts of this acid.

DETERMINATION OF IRON BY PERMANGANATE AFTER REDUCTION BY TITANOUS SULPHATE. *H. D. Newton. Zeitsch. Anorg. Chem., 1908, 58, 378-380.*

The sulphuric acid solution of the iron is reduced by means of titanous sulphate solution, the excess of which reagent is eliminated by the addition of bismuth oxide; after filtration the solution is titrated with standard permanganate. A correction should be made for any iron present in the titanous solution, and the solution which is titrated must not contain any hydrochloric acid.

CAUSE OF THE DECOLORIZATION OF LIQUIDS BY DIFFERENT FORMS OF CHARCOAL. *F. Glassner and W. Suida. Annalen, 1907, 357, 95-128; ibid., 1908, 361, 353-362.*

On the assumption that charcoal serving for decolorizing purposes is not chemically indifferent, that its constituents are capable of forming chemical compounds with the colouring matter, and that the carbon must contain chemically active groups, the authors have analysed a variety of charcoals from different sources, and tested these for their decolorizing powers against carefully purified dye stuffs. It was found that vegetable charcoals, containing only traces of nitrogen and small amounts of ash, decolorize badly, whereas animal charcoals with relatively high nitrogen and ash contents have generally high absorptive powers. Of the animal charcoals those giving the best results were found to contain the smallest amount of nitrogen but the highest ash content. Further experiments showed that the concentration of the coloured solution was without influence, but that the presence of inorganic salts, particularly sodium chloride, in the solution undergoing decolorization increased the absorptive properties of the charcoal.

It is believed that the decolorizing power of charcoal is dependent on the presence of cyanogen compounds. It has, indeed, been previously shown that these bodies are capable of precipitating and of decolorizing solutions of certain dyestuffs. It was found experimentally by the authors that basic dyes are completely precipitated from solution by potassium ferrocyanide, potassium ferricyanide, potassium thiocyanate, cyanuric acid, ammelide, and ammeline, but only slowly by melamine and melam. The latter two compounds are capable of decolorizing solutions of molasses, of raw sugar, or of tannin to the extent of more than 50 per cent. This view that the colour absorptive power of charcoal is brought about by the presence of cyanogen compounds finds further confirmation in the fact that an inactive charcoal (prepared from gelatine or wool) containing much nitrogen can be rendered active and capable of decolorization by fusion with caustic potash, potassium carbonate, or, to a lesser extent, with potassium chloride.

The authors have further examined varieties of lampblack and carbon from acetylene as to the cause of their decolorizing action towards solution of dyestuffs. Both kinds of charcoal were ash and nitrogen-free. The aqueous and alcoholic extracts from the lampblack were both found to be without action; benzene, to the contrary, dissolved out an oily substance which showed a considerable affinity towards basic dyestuffs. It was also found that by treatment with acids, alkalis, or suitable solvents both lampblack and acetylene carbon can be rendered inactive.

The decolorizing power of lampblack appears to increase with the amount of oxygen, and more particularly with the kind of oxygen compound it contains. Probably its action in this respect is due to the presence of soluble or insoluble phenolic compounds. The authors, indeed, show by a number of tests that the majority of the phenols have the power of combining with basic dyestuffs to a high degree. The decolorizing action of lampblack is probably to be explained by the presence of complicated compounds which are capable of forming products like the oxonium or carbonium compounds.

NEW PROCESS OF JUICE PURIFCATION. *F. Strohmer. Öst-ung. Zeitsch. f. Zuckerind., 1908, 37, 199-202;* through *Chem. Centr., 1908, 2, 269-270.*

The writer has examined a recently invented process* for the purification of sugar juices by means of hypochlorous acid salts. Bleaching powder and milk-of-lime are added to the heated juice, which is then sulphured to slight alkalinity or neutrality towards phenol-phthalein. The process is more applicable to juices from which the eliminable impurities have been removed by the ordinary

* R. Hafner, J. Vrestrál, and O. Biemer. Austrian Patent, 30849.

methods, and is claimed to be well adapted for the manufacture of cube sugar. It was found that juices thus heated were decolorized, and that no inversion took place.

POTASSIUM MANURING OF BEET SOILS. *E. Saillard. Bied. Zentr. 1908, 37, 426-427;* through *Jl. Chem. Soc., 1908, 93-94; Abs. ii. 618.*

Determinations of sugar, potassium, and sodium in sugar beet from all parts of France where they are grown, showed that with diminished percentages of sugar there is a regular increase in the sodium expressed as a percentage of the ash soluble in hydrochloric acid. The potassium was found to vary very slightly. Roots containing 16-17% of sugar contained 3·6% K_2O and 5·0% Na_2O in the soluble in water portion of the ash, whilst roots with 8-11% of sugar contained 38·0% K_2O and 17·5% Na_2O. The paralysing effect of sodium is shown by results obtained near the sea, where it is impossible to grow beets with high percentages of sugar. In manuring sugar beet, sodium nitrate should be employed in moderation. The following manures are recommended: super-phosphate, 300-500 kilos.; potassium (as sulphate, chloride, or kainite), 75-90 kilos.; nitrogen (as sodium nitrate), 25-40 kilos. per hectare, and the rest of the nitrogen in an organic form as farm-yard manure.

POTASH CONSUMPTION OF THE BEET DURING ITS FIRST YEAR'S GROWTH, AND ITS BEARING ON THE SUGAR CONTENT OF THE ROOT. *K. Andrlik and J. Urban. Zeit. Zuckerind. Böhm., 1908, 32, 559-575.*

In continuation of previous work it is now stated that the amount of potash consumed by the beet during its first year's growth is capable of being influenced by the nature of the soil, the manuring and weather conditions, and the kind of seed selected. Under the most favourable conditions the minimum amount of potash was found to be 156·9 kilos. per dz. of roots. Generally the amount is greater. Potash salts or farm-yard manure increase the potash consumption. The size of the root and the sugar content depend only to a certain extent on the potash absorbed. For 100 parts of sugar the amount of potash taken up by the root was found to vary between 2·1 and 5·8 parts. A greater proportion of potash is found in the stalks than in the root; generally 30-40 per cent. of the total potash taken up is found in the latter, and with an increase of the total potash consumed by the beet, the percentage found in the root decreases. The quantity of potash accumulating in the root varies with different kinds of seeds; for technical purposes it is well to use beets absorbing the least amount of potash into their roots.

Action of Manganese on the Growth of Sugar Beet. *H. Grégoire, J. Hendrick, and E. Carpiaux. Bull. Inst. Chim. Bact. 1908, 75, 67-72*; through *Jl. Chem. Soc., 1908, 93-94, Abs. ii. 529.*

Results of field experiments with sugar beet showed an application of manganous sulphate at the rate of 50 kilos. per hectare diminished the yield of roots and increased the percentage of sugar in the root: the ultimate yield of sugar was the same in both cases.

Activity of Calcium Cyanamide under Different Manurial Conditions. *I. Namba and C. Kanomata. Bull. Coll. Agric. Tokio Imp. Univ. 1908, 7, 631;* through *Chem. Zeit., 1908, 32, rep. 362.*

Calcium cyanamide, an alkaline fertilizer, gives a better result in combination with superphosphate than when mixed with neutral phosphates; it does not influence the action of bone meal, resembling ammonium sulphate in this respect.

Other subjects are:—

Cane Sugar Experiments: *Annual Report (1907) of the Porto Rico Experimental Station.*

Formation of "Kalkstickstoff." *M. Jacoby. Dissertationschrift, Techn. Hochschule, Dresden, 1908, 86;* through *Chem. Zeit., 1908, 32, rep. 412.*

Molasses for Farm Stock. *Bull. Mass. Agric. Expt. Station, No. 118.*

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. Thompson, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; 77, Market Street, Bradford; and 322, High Holborn, London.

ENGLISH.—Abridgments.

22256. R. Mitchell, Pollockshields, Glasgow. *An improved roll for sugar cane mills.* 9th October, 1907. This invention relates to rolls for sugar cane mills, the construction of the face (or body) with graduated rings of triangular-shaped teeth arranged parallel with the axis of the roll; with each alternate ring of teeth arranged hit and miss fashion, and having the tortuous or zig-zag gutters around the circumference of the body of the roll.

22427. R. MITCHELL, Pollockshields, Glasgow. *Improvements in rolls for sugar cane mills.* 11th October, 1907. This invention relates to rolls for sugar cane mills, the construction of the face (or body) with circumferential rings of triangular-shaped teeth arranged parallel with the axis of the rolls; with each alternate ring of teeth arranged hit and miss fashion, and having the tortuous or zig-zag gutters around the circumference of the body of the roll.

GERMAN.—ABRIDGMENTS.

198168. CARL RENNER, of Breslau. *A process for obtaining beet-root juice by diffusion, in which the drawing off and mashing is carried out simultaneously.* 14th December, 1906. The chief feature in this arrangement consists in the drawing off taking place from a previous diffuser and not from the one in which the fresh mashing has taken place, a second draught being taken from this previous diffuser and employed during the mashing in such a way as to first expel the juice from the succeeding diffuser and the expelled juice is then used for mashing a third diffuser filled with fresh shreddings.

198285. FRANZ BEDUWÉ, of Liège, Belgium. *Apparatus for simultaneously lifting and washing beetroot and other material which floats in running water.* 5th January, 1907. This apparatus consists of an elongated lift pipe provided with an air-feeding apparatus and a shorter drop pipe connected by a bend with the former and the peculiarity consists in the lift pipe being so much smaller than the bend and the fall pipe, that by the increased speed of the mixture of water and air in the lift pipe, the speed of fall of the material conveyed produced by the admission of the air is avoided.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of July, 1907 and 1908.

IMPORTS.

Raw Sugars.	Quantities.		Values.	
	1907. Cwts.	1908. Cwts.	1907. £	1908. £
Germany	4,664,284	4,228,725	2,188,594	2,270,779
Holland	157,807	100,801	75,100	50,430
Belgium	218,928	161,609	97,810	88,657
France	274,971	254,263	139,121	151,905
Austria-Hungary	283,252	436,211	127,658	233,727
Java	165,728	630,488	87,121	305,225
Philippine Islands	187,693	215,055	77,287	88,962
Cuba	91,113	....	39,600	....
Peru	307,495	659,940	148,328	360,714
Brazil	189,295	1,712	78,150	788
Argentine Republic	....	....	....	....
Mauritius	440,710	368,993	180,811	163,273
British East Indies	98,658	155,926	43,081	69,449
Straits Settlements	110,538	82,314	46,270	36,928
Br. W. Indies, Guiana, &c.	1,011,427	677,525	585,987	474,789
Other Countries	489,810	443,425	241,279	248,373
Total Raw Sugars	8,691,709	8,416,987	4,156,197	4,543,999
Refined Sugars.				
Germany	8,034,725	8,426,084	4,730,865	5,461,870
Holland	1,544,315	1,453,355	973,027	999,817
Belgium	177,295	100,249	107,907	65,684
France	2,126,186	1,294,155	1,239,034	859,849
Other Countries	2,606	176,964	1,805	115,220
Total Refined Sugars	11,885,127	11,450,807	7,052,638	7,502,440
Molasses	1,698,617	1,540,684	328,627	314,793
Total Imports	22,275,453	21,408,478	11,537,462	12,361,232

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	292	673	220	280
Norway	8,977	5,750	5,418	3,766
Denmark	60,802	57,550	32,676	35,091
Holland	39,941	38,297	26,845	27,419
Belgium	5,578	4,553	3,363	3,147
Portugal, Azores, &c.	13,421	8,594	7,472	5,283
Italy	13,445	4,898	7,121	2,956
Other Countries	273,996	168,563	204,311	132,132
	416,452	288,878	287,426	210,074
Foreign & Colonial Sugars				
Refined and Candy	21,265	9,770	13,928	7,603
Unrefined	54,748	329,208	32,731	207,185
Molasses	4,035	2,194	1,164	915
Total Exports	496,500	630,050	335,249	425,777

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1908. Tons.	1907. Tons.
Total Receipts Jan. 1st to Aug. 20th	1,365,260	1,416,160
Receipts of Refined ,, ,,	830	670
Deliveries ,, ,,	1,342,490	1,398,164
Importers' Stocks, Aug. 19th	28,390	17,996
Total Stocks, August 26th	256,000	284,300
Stocks in Cuba, ,,	64,000	86,000
	1907.	1906.
Total Consumption for twelve months	2,993,979	2,864,013

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1907 AND 1908.

(Tons of 2,240lbs.)	1907. Tons.	1908. Tons.
Exports	1,217,259	815,397
Stocks	155,060	94,242
	1,372,319	909,639
Local Consumption (7 months)	26,730	34,390
	1,399,049	944,029
Stock on 1st January (old crop)	...	9,318
Receipts at Ports up to July 31st	1,399,049	934,711

Havana, July 31st, 1908. J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR SEVEN MONTHS, ENDING JULY 31ST, 1908.

SUGAR.	Imports. 1906. Tons.	Imports. 1907. Tons.	Imports. 1908. Tons.	Exports (Foreign). 1906. Tons.	Exports (Foreign). 1907. Tons.	Exports (Foreign). 1908. Tons.
Refined	525,154	594,256	572,540	1,361	1,063	488
Raw	482,688	434,585	420,849	6,823	2,737	16,460
Molasses	80,450	84,931	77,034	273	202	110
Total	1,088,292	1,113,772	1,070,423	8,457	4,002	17,058

	Home Consumption. 1906. Tons.	Home Consumption. 1907. Tons.	Home Consumption. 1908. Tons.
Refined	504,643	571,456	544,348
Refined (in Bond) in the United Kingdom	327,450	290,314	306,726
Raw	73,343	71,749	69,363
Molasses	73,776	76,930	71,183
Molasses, manufactured (in Bond) in U.K.	34,330	37,912	39,275
Total	1,013,542	1,048,361	1,040,895
Less Exports of British Refined	26,920	20,823	14,444
Total Home Consumption of Sugar	986,622	1,027,538	1,026,451

Stocks of Sugar in Europe at uneven dates, August 1st to 22nd. compared with previous Years.

In thousands of tons, to the nearest thousand.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	Total 1908.
153	375	271	260	60	1120

	1907.	1906.	1905.	1904.
Totals	1283 ..	1558 ..	1107 ..	1478

Twelve Months' Consumption of Sugar in Europe for Three Years, ending July 31st, in thousands of tons.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria-Hungary	Holland, Belgium, &c.	Total 1907-08.	Total 1906-07.	Total 1905-06.
1873	1183	652	552	205	4456	4514	4226

Estimated Crop of Beetroot Sugar on the Continent of Europe for the current Campaign, compared with the actual crop of the three previous Campaigns.

(From Licht's Monthly Circular.)

	1907-1908. Tons.	1906-1907. Tons.	1905-1906. Tons.	1904-1905. Tons.
Germany	2,132,000 ..	2,239,179 ..	2,418,156 ..	1,598,164
Austria	1,430,000 ..	1,343,940 ..	1,509,789 ..	889,431
France	725,000 ..	756,094 ..	1,089,684 ..	622,422
Russia	1,410,000 ..	1,440,130 ..	968,500 ..	953,626
Belgium	235,000 ..	282,804 ..	328,770 ..	176,466
Holland	175,000 ..	181,417 ..	207,189 ..	136,551
Other Countries .	435,000 ..	467,244 ..	410,255 ..	332,098
	6,542,000	6,710,808	6,932,343	4,708,758

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The Editor will be glad to consider any MSS. sent to him for insertion in this Journal and will endeavour to return the same if unsuitable; but he cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTICE TO READERS.—If the Advertisement pages stick together, bang their edges on the table, when they should easily separate.

NOTES AND COMMENTS.

The B 208 Cane in British Guiana.

It will be a matter of recollection that just a year ago we were involved in an acrimonious controversy regarding the B 208 canes on the Plantation Diamond, British Guiana, the identity of which we felt bound to question. We were obliged in the end to admit that our informant must have been mistaken, but the circumstances under which he fell into his error were so noteworthy, that we had no doubt at the time that further light would be shed on the matter ere many more months were past. We have now had the opportunity of studying the official Progress Report by the Director of Science and Agriculture (Prof. J. B. Harrison, C.M.G.) on the Agricultural Experiments carried out during the half-year, October-March, 1907-08, at the Government Experiment Stations, Demerara, B.G., and it has some interesting information to set on record with regard to this cane. In the first place we are told that:—

"As in 1905 and in 1906 B 208 did not give relatively high field-results; the trials with it under various systems of manuring on North field, some comparative trials made with plots of it, raised from cuttings obtained from several different sources, in North-West field, and those in the Brickdam field were all, in view of its high reputation, more or less unsatisfactory and in no case did it grow with vigour. These general results have confirmed me in the opinion expressed in the Progress Report for 1905 that B 208 is

unsuitable for cultivation on very heavy clay soils such as those of the Experimental Fields. It is, however, possible that by continued cultivation in the course of years this may be remedied; in fact there are signs that the variety is increasing in vigour on the plots in the Brickdam field and in the North field. As in all previous trials at the Experimental Fields B 208 was characterized by the high sugar contents and marked purity of its juice."

But more important to the controversy is the account of a visit paid to the Station by Sir Daniel Morris himself, to inspect the canes to whose original propagation and subsequent development he had given so much care and attention. To quote the report:—"During his "visit of inspection to the Experimental Fields on November 15, "1907, the Commissioner of Agriculture for the West Indies carefully "examined this cane where growing on each of the fields. He "expressed himself as being especially struck with the extraordinary "modifications in character and in its mode of growth shown by the "B 208 canes grown on the North and North-West fields, and stated "that he had seldom, if ever, seen canes showing more unsatisfactory "field-characteristics than these did. His attention was called to the "fact that on certain plots of the variety the characteristics always "shown by B 208 when growing on suitable soils, were entirely or "almost entirely absent, whilst he stated that *he failed to recognize "as this variety plants the progeny of cuttings which he had personally "supplied me with in 1903 as being typical B 208. These canes showed "in their morphological characters a strong resemblance to stunted "specimens of the White Transparent.*"*

"Specimens of these were exhibited at the Agricultural Conference "in Barbados in January, 1908, side by side with canes of the same "kind grown by Mr. J. R. Bovell in Barbados, and much interest "was shown by the planters present in the extraordinary difference "between the latter magnificent specimens of canes and the stunted "canes from our fields. The Commissioner specially alluded, in the "course of discussion, to what he had noticed during his inspection "of the Experimental Fields."

When the Imperial Commissioner of Agriculture is himself nonplussed by the results of the propagation of this seedling in British Guiana, we may well ask if we were deserving of all the tirade of abuse which was heaped on us by certain sections of the West Indian press because we gave voice to a belief that the Diamond Plantation B 208's were not actually of that variety? And was there really justification for an Official Department to go to the length of reprinting this tirade in pamphlet form and circulating it amongst the whole body of readers of their official publications, as we have good reason to believe they did? We think if less haste and resentment had been shown and a little more trouble had been taken to arrive at the true facts, a much more temperate denial would have been forthcoming.

* The italics are ours (*Ed.* I.S.J.)

And when we bear in mind that British Guiana is entirely outside the sphere of operations of the Imperial Commissioner of Agriculture for the West Indies, it is all the more a matter for surprise that so much acrimony was shown in Barbados, the head-quarters of his Department (as exemplified in the articles appearing in the press of that island) when we ventured to refer to a mystery relating to British Guiana. It is now fairly clearly established that B 208 is a cane variety subject to most unusual modifications in character and mode of growth; and, again, in the opinion of some of those best qualified to judge, it is too much subject to marked fluctuations in its yields, according to soil and season, to justify its wider adoption. When it does succeed, it undoubtedly succeeds well; but, contrariwise, when it fails, as it does at times, it fails badly. We should, however, be glad to know how the Plantation Diamond specimens have turned out this year. Have they been a success or not? Considering that the Diamond authorities have pinned their faith to this variety more than any other British Guiana plantation has, they might surely enlighten us as to the latest results of growing this cane. For if they can prove that their experience has been the exact opposite of that of the Experiment Station, we must admit that the verdict is still "not proven," as the Scotch say; but if their luck has been no better, then our prognostications have been, in a measure, justified. Will Mr. Fleming tell us what his actual experience with them has been?

Mills in Formosa.

The *Chemiker Zeitung* commenting on the importance of the sugar producing capacity of Formosa, observes with satisfaction that most of the cane sugar central factories are supplied with machines from German shops, and states that a Braunschweig firm have just delivered a 1000-ton plant complete. The last item of intelligence is doubtless true, but the assumption that continental firms have supplied the bulk of the new cane plants to Formosa strikes us as entirely gratuitous, unless we are to believe that these manufacturers love to hide their light under a bushel, and never advertise the fact that they have secured a big order. Most of the recent plants erected in Formosa have been ordered from British or American houses, if current reports count for anything. It is true such reports are liable to be discounted, in the literal sense, as they mostly emanate from biassed sources, and we do not admire the ethics shown by a certain firm who, it is said, announced in the papers their receipt of an important Formosan contract before the latter was actually given out; and in the end did not get the contract at all. Still making every allowance for discrepancies between the published announcement and the real facts, we do not think there is evidence to justify our contemporary's claim on behalf of its engineering trade.

A Beet Sugar Plant for South Africa.

The following information we take from a South African contemporary :—

Beet Sugar Machinery.—According to the Bureau of Manufactures, Washington, an American Consul in South Africa reports that a company is being organised for the purpose of establishing a factory for the manufacture of sugar from beet. The promoter of the plan has requested the Consul to furnish him the names of firms from which he can secure plans, specifications, and quotations for the necessary machinery for a mill capable of treating 300 tons of beet per day, and the time it would take from the date of receiving an order to have the same erected. British firms who may desire to furnish this information should address No. 2484, Bureau of Manufactures, Washington, U.S.A.

We give the statement for what it is worth but it strikes us as extraordinary that British firms should have to apply to a United States Official Department for information regarding a concern in a British colony. Are we to presume that this new venture is planned and will be financed by Americans? At any rate there are not wanting reports as to movements on the part of American financiers to get a footing in British sugar undertakings; and one recent rumour, which we give with all reserve, has it that an attempt is being made by these Americans to seize the British sugar refining industry. Whether they would succeed or not seems to us to depend on the outlook for the British refineries during the next few years.

Antigua's Finances.

The *British Empire Review* draws attention to the fact that for the first time since 1892 the revenue of Antigua, for the year 1907-08, has exceeded the expenditure. This, our contemporary adds, has been almost entirely due to the Brussels Convention which, by reviving the credit of the sugar industry, enabled the planters to erect modern sugar machinery and labour-saving appliances. Thus, from being one of the most backward of the West Indian islands, Antigua has become an object lesson to her neighbours in all that concerns enterprise and development. One is glad to be able to record these facts, as it was one of the chief claims of the supporters of the Convention that credit would be restored and thereby enable progressive enterprise to succeed. Only, the results could not be achieved at a moment's notice and, meanwhile, scoffing opponents have had the field largely to themselves. Elsewhere we reproduce a paper on the Antigua Central Mills which was read at the last West Indian Agricultural Conference by the Hon. Francis Watts, C.M.G., one of the chief promoters of the scheme for modernizing the Antiguan sugar industry. Considerable interest was aroused by the favourable financial statistics given to the meeting, and we hope the success achieved so far will prove an irresistible inducement to Barbados to

start a central factory of her own and see if the modern process of manufacture will not pay even better than the older muscovado process has done for so long. The discussion which followed on the reading of the paper showed, however, that some of the Barbadians are still unconvinced that their own pet system can be improved on.

Queensland's Sugar Industry.

The Queensland Government statistician has issued his report on the sugar crop for 1907. The output, he states, was a record, due to the very high sucrose contents of the cane cut, especially at Ingham, Mourilyan, Ayr, and Mackay. Still, the areas cultivated and crushed and the tonnage of sugar were smaller than in the previous year. The area cultivated was 126,810 acres, of which 94,384 acres were crushed. The yield of cane was 1,665,028 tons, and of sugar 188,307 tons. The acreage under cane was 6,474 acres less than in 1906; the area crushed showed a decrease of 3,810 acres. The output of sugar has been: 1903, 91,828 tons; 1904, 147,688 tons; 1905, 152,722 tons; 1906, 184,377 tons; 1907, 188,307 tons.

The yield of cane per acre last year was 17·64 tons as compared with 17·61 tons in 1906, 14·73 tons in 1905, 16·04 tons in 1904, and 1·52 tons in 1903. The yield of sugar last year was two tons to the acre, compared with 1·88 tons in 1906, 1·59 tons in 1905, 1·78 tons in 1904, and 1·52 tons in 1903. The tons of cane to the ton of sugar were 8·84 tons in 1907, 9·38 in 1906, 9·27 in 1905, 8·99 in 1904, and 8·97 in 1903.

There were 54 establishments engaged in the manufacture of sugar from the cane, employing 4497 hands. The value of the machinery was put at £1,693,124, and of the land and premises at £243,115. The consumption of sugar in the Commonwealth is put down at 191,416 tons, and in New Zealand at 42,673 tons. The production in Queensland last year was 188,307 tons, and in New South Wales 23,418 tons, or 211,725 tons in all, or 19,859 tons in excess of the consumption.

But while Queensland's share is certainly the largest this decade, that of New South Wales is the smallest since 1899. This latter is said to be due to the farmers in that more temperate clime finding dairying more profitable than sugar cane cultivation.

Zululand.

The *Board of Trade Journal* announces that a central mill for crushing sugar cane was opened at Amatikulu on August 6th. It is stated that eighty-five lots, comprising about 50,000 acres, have been taken up between the Tugela and Umlalazi rivers. The settlers are bound to cultivate a fixed proportion of the area they hold, the cane

to be purchased by the mill-owners at rates varying according to the market prices of sugar. The capacity of the present mill is limited to an output of 7000 tons of sugar per annum, but the agreement made by the Government with the mill-owners binds them to provide means for manufacturing, in an extension of the existing mill, or in another mill, an additional quantity up to a maximum of 15,000 tons per annum.

THE STRIPPING OF SUGAR CANE IN FORMOSA.

By T. Murakami; B.Sc.

In Formosa a peculiar custom of stripping the sugar cane has prevailed from a very early period, which, whatever reason be given for it, has resulted in benefit to the plants. One species, *Ancha* (Scarlet Cane, so called from its colour) always has its dead leaves stripped a week or two before cutting begins, so as to give a fair appearance of colour to the stalk, and as regards others, such as *Rôcha* (Waxy Cane) and *Tekucha* (Bamboo Cane), the natives treat them in the same way, with the object of obtaining fuel; but there lies no scientific purpose behind such a practice, Up to the present, the opinion of practical farmers at home and abroad is in favour of constant removal of all dead leaves for the following reasons: that the cane ripens earlier and acquires a depth of colour; that such a proceeding deprives noxious insects of a breeding ground; that the cane is provided with the necessary circulation of air and light in and around it; that the withered leaves so removed cover the soil, and so check undue evaporation of moisture and thus benefit the canes; and that the expense thus incurred in stripping may be more than covered by an increased output of cane.

Stripping experiments with varieties of cane.

The urgent necessity of investigating this problem of stripping was brought to our notice last crop, when we carried out some experiments with that object. Each variety plot was divided into two parts, and from one of them all the dead leaves were twice carefully stripped off at intervals of a month, while the other was left untouched; both being subject to the same conditions of cultivation. At the beginning of the milling season, in December, each plot was cut, weighed carefully and the products analysed when the following results were obtained:—

RESULTS OF INVESTIGATION ON THE VARIETIES OF CANE.

	Kind of Cane.	How treated.	Yield of Cane per Cho in Kin.*	Amount of Available Sugar per Cho in Kin.	Physical Examination.				Chemical Composition (in 100 parts of Cane).					Analysis of Juice.			Available Sugar on 1000 Cane in Kin.
					Height of Cane.	Height of Stalk.	Circumference of Stalk.	Weight of Stalk.	Moisture.	Ash.	Sucrose.	Invert Sugar.	Fibre and Non-sugar.	Total Solid Matter.	Sucrose.	Purity Coefficient.	
					Metres.	Metres.	c.m.	grm.	%	%	%	%			%		
Formosan Varieties.	(Bamboo Cane) Tekucha.	Stripped	122,345	14,918	3·65	2·49	6·69	883·3	74 588	·388	13·288	·871	10·865	17	14·5	85·3	122·1
		Unstripped	1,015,418	12,186	3·41	2·4	5·58	736·7	75·232	·392	13·168	1·187	10·021	17·5	14·2	81·5	120·
	(Scarlet Cane) Ancha.	Stripped	93,139	13,533	2·67	1·29	7·59	842·3	72·476	·328	15·444	1·077	10·675	19 7	17·2	87·3	145·3
		Unstripped	99,659	13,055	3·15	1·64	7·29	901·7	74·200	·364	14·037	1·321	10·078	18·5	15·7	84·7	130·9
	(Waxy Cane) Rocha.	Stripped	111,219	13,346	3·28	2·02	9·51	1011·7	75·068	·320	12·965	1·038	10·609	16·5	14·5	87·9	119·9
		Unstripped	111.271	14,020	2·74	1·57	9·3	1083	74·688	·368	13·577	·882	10·485	17·5	15	85·7	125·9
Imported Varieties.	Striped Singapore.	Stripped	88,127	10.487	3·48	1·74	13·71	1954·7	74·460	·278	12·560	2·023	10·679	17·2	14	81·4	118·9
		Unstripped	90,790	10,892	3·6	1·74	13·68	2008·3	74·928	·400	12 826	1·415	10·431	17·5	14·5	82·8	119·9
	Rose Bamboo.	Stripped	103,169	15,578	4·08	2·19	10·8	2111·3	72·760	·320	15·888	·536	10·496	19·5	17·5	89·6	150·9
		Unstripped	99,982	16,797	4·01	2·09	10·5	1800	72·664	·290	17·226	·337	9·483	20·1	18·9	94	168
	Malitius Gingham.	Stripped	46,145	7,383	4·06	2·41	10·59	980	72·930	·260	17·733	·407	8·670	22·9	19·5	85	159·9
		Unstripped	45,222	7,914	2·97	1·54	9·81	958·3	71·692	·210	18·659	·194	9·245	23·8	20·5	86	175

* 1 Kin = 1·3 lbs, = ·6 kilogram; 1 Cho = 2·45 acres = 9917·4 sq. metres.

The effects of stripping on the various species, as compared with the unstripped portions, may be summarized as follows :—

(1) In each variety of cane, the size of stalk is remarkably increased.

(2) With the exception of the *Ancha* and the *Striped Singapore*, both of them scarlet in colour, the cane stalks were found to be standing much more erect.

(3) In all the varieties except the two Formosan species *Tekucha* and *Ancha* and probably the *Striped Singapore* (all of which are hard-rind canes), the water content and the rate of absorption of mineral salts were greatly increased and in the juice the purity coefficient was noticeably lowered.

(4) But less sucrose and more glucose are found contained in the juice from stripped canes, except in the case of the *Ancha* and *Tekucha*, in which the effect seems rather the opposite one.

(5) Fibre and other non-sugar organisms are markedly increased and seem to have influenced a decrease in the content of juice.

(6) *Rocha*, *Ancha*, and *Striped Singapore*, gave a smaller tonnage, but in the other varieties it was increased by stripping, especially in the case of *Tekucha* where the difference was considerable. In the case of *Rose Bamboo*, which is now extensively cultivated in Formosa, the difference amounts to as much as 3987 kins per cho (2148 lbs. per acre) equivalent in money value to 11·961 yen (24s. 6d.), which would yield a profit to the farmer after incurring the cost of stripping.

(7) The amount of available sugar in the cane is greater (excepting *Tekucha*) ranging from 500 to 1220 kins of sugar per cho* (269 to 653 lbs. per acre), also 1 to 18 kins on 1000 kins of cane; or in money value, 0·08 to 1·44 yen on every 1000 kins of cane.

Experiments in cane stripping under different conditions of manuring.

Would different fertilizers alter the conditions so obtained? In the manurial experiment plots, calcium superphosphate as phosphoric acid, ammonium sulphate as nitrogen, and potassium sulphate as potash were carefully applied, each in excessive quantities. Each plot was further sub-divided into two sections, in one of which the cane was constantly stripped and the dead leaves left to cover the ground till the end of the season, while the other section was left untouched. The following results were obtained :—

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* 1 kin = 1·32 lbs.; 1 cho = 2·45 acres.

RESULTS OF STRIPPING ON THE MANURIAL EXPERIMENT PLATS. (THE CANE USED FOR EXPERIMENT WAS ROSE BAMBOO.)

Fertilizer used.	How treated.	Yield per Cho in Kin.*	Amount of Available Sugar per Cho in Kin.	Physical Examination.				Chemical Composition (in 100 parts of Cane).					Purity Co-efficient.	Available Sugar on 1000 Canes in Kin.
				Height of Cane.	Height of Stalk.	Circum-ference of Stalk.	Weight of Cane.	Moisture.	Ash.	Sucrose.	Glucose.	Fibre and Non-sugar.		
				Metres.	Metres.	c.m.	grm.	%	%	%	%			
No Manure.	Stripped	129,380	17,427	3·19	1·34	9·1	671·2	73·937	·389	13·976	1·110	10·588	91·97	134·7
	Unstripped	127,093	17,535	2·8	1·15	9·1	657	73·400	·377	14·289	·907	11·027	92·02	137·9
Phosphoric Acid omitted.	Stripped	140,316	14,301	3·63	1·66	11·1	1273	76·510	·374	11·400	1·752	9·964	79·4	111·9
	Unstripped	129,091	15,878	3·62	1·66	10·2	1170	71·780	·304	13·46	1·643	12·813	82·4	122·9
Nitrogen only.	Stripped	129,878	14,935	3·64	1·75	10·3	1712	75·240	·292	12·385	·972	11·111	86·6	114·9
	Unstripped	119,488	15,185	3·6	1·54	9·5	1547	74·250	·490	13·265	1·237	10·758	89·5	127
Manure completed.	Stripped	164,409	20,715	3·84	1·92	10·1	1415	72·504	·290	13·600	1·425	12·081	84·7	125·9
	Unstripped	159,960	20,954	3·62	1·72	10·	1167	72·880	·290	14·000	1·824	11·006	88	130·9
Potash omitted.	Stripped	160,300	18,274	3·54	1·68	10·2	1126	73·710	·200	12·500	1·722	11·868	82	115·9
	Unstripped	157,160	18,387	3·36	1·52	9·8	922	74·780	·250	12·700	1·242	11·028	84·3	116·9

* Kin = 1·3 lbs. = ·6 kilogram; Cho = 2·45 acres = 9917·4 sq. metres.

In comparing the results with the conclusions obtained from the previous experiments (omitting a few minor modifications and irregularities observed in the complete manurial plot from unaccountable reasons which require further investigation) the results as a whole have verified previous conclusions and have furthermore shown that the effect of stripping canes when different manures are applied is felt most largely in those plats in which phosphoric acid is omitted or nitrogen is heavily present. In such cases the largest crops are found when the canes are stripped; and the least when no potash manure is present. But, on the other hand, the loss of available sugar obtainable per cho and also on 1000 kins of cane is surprisingly great.

Experiments in stripping the dry leaves from the canes.

Stripping off the dry cane leaves seems rather wanton treatment from a scientific standpoint. Is there really any advantage *from a manufacturing point of view* in cutting off the withered leaves as is universally done in Formosa? In another series of experiments canes in the different plats were controlled under different conditions of cultivation. The canes in one-half of each plat were carefully deprived of their dry leaves while being left untouched in the other; and the two portions were separately subjected to a juice extraction of 75, and the composition of the expressed juice was determined with the following results:—

(1) Experiment on the Juice of the Rose Bamboo.

No.	Analysis of the Juice from Unstripped Canes.				Analysis of Juice from Stripped Canes.			
	Sucrose.	Grucose.	Density (Brix).	Purity Coeff.	Sucrose.	Grucose.	Density (Brix).	Purity Coeff.
1	19·805	·768	23·38	84·71	19·805	·666	23·38	84·8
2	19·044	·386	23·17	82·18	19·044	·274	23·17	82·1
3	18·898	·243	22·57	83·73	18·282	·192	22·57	81·0
4	18·282	·896	20·57	88·87	17·977	·982	20·27	88·6
5	18·640	·400	21·67	86·00	18·282	·400	21·67	84·3
6	19·400	·540	22·57	85·00	18·400	·640	21·67	84·8
7	19·805	·384	23·57	84·03	19·805	·427	23·57	84·4
8	17·200	·421	20·2	85·00	17·230	·421	20·00	85·8
9	....	....	....	....	...	....	....	....
10	....	....	....	....	....	....	....	....
Average	18·89	·505	22·2	84·94	18·61	·500	22·04	84·5

(2) Experiment on the Juice of Tekucha (Bamboo Cane).

No.	Analysis of the Juice from Unstripped Canes.				Analysis of Juice from Stripped Canes.			
	Sucrose.	Grucose.	Density (Brix).	Purity Coeff.	Sucrose.	Grucose.	Density (Brix).	Purity Coeff.
1	16·300	·320	19·76	82·49	16·758	·349	19·72	84·97
2	16·758	·670	20·44	81·98	16·454	·690	20·44	80·49
3	17·215	·574	20·38	84·87	16·910	·437	19·38	87·25
4	15·538	·816	19·00	81·77	15·083	·961	19·27	79·00
5	16·453	·644	20·00	82·27	15·315	·549	19·38	79·00
6	15·083	·744	19·00	79·30	15·387	·694	19·00	80·98
7	15·402	·528	19·00	81·06	15·300	·564	18·90	80·95
8	15·960	·470	19·27	82·80	15·996	·482	19·27	83·00
9	15·844	·400	18·75	84·50	16·454	·390	18·25	89·06
10	16·758	·460	19·00	88·20	16·758	·480	18·25	91·80
11	16·758	·349	19·27	86·90	16·300	·640	19·76	82·48
Average	16·188	·543	19·44	83·28	16·068	·567	19·24	83·54

From such an incomplete experiment as the above we learn that the juice has not deteriorated much from the retention of the dry leaves but that on the contrary the purity coefficient, sucrose, and consequently available sugar have been slightly increased.

Conclusions.

It may be thought unwise and unscientific to draw general conclusions from only partial investigations carried out in Formosa, which island may differ somewhat in climatic conditions and methods of cultivation from other sugar-producing countries: yet the results obtained thus far might be of some interest and value to the sugar industry as to be worth recapitulating. The conclusions of these experiments may therefore be given as follows:—

(1) The decrease in sucrose and the lowering of the purity coefficient and the simultaneous increase in glucose and fibre in the imported canes when stripped may be interpreted as due to a chemical activity having taken place, non-sucrose having been transformed into sucrose and sucrose into glucose.

(2) This chemical activity may be influenced in the presence of a large amount of salt absorbed along with water.

(3) The fresh food material thus obtained is expended in the growth of the canes, an increase in their weight and size, but strange to say the coloured canes for some mysterious reason are exceptions to this supposition.

(4) A long exposure to the hot sun causes the rind or peel of the stalk to become much harder, especially around the joints, thus increasing the fibre content. This is not, however, the case in the Formosan varieties and the *Striped Singapore*, all of which are rather hard in rind and thus resist the absorption of water and salt when the canes are stripped and brought to maturity.

(5) The different kinds of manures do not alter these conclusions except in minor cases chiefly concerned with the nitrogen plat and the complete manure plat.

(6) The *Rose Bamboo* being a very promising cane for extension in Formosa, the amount of cane and available sugar yielded by it per cho is shown in the following figures:—

How Treated.	Unmanured Plat.				Manured Plat.			
	Cane.	Available Sugar.	Sucrose on Cane.	Purity Coeff.	Cane.	Available Sugar.	Sucrose on Cane.	Purity Coeff.
	Kin.	Kin.	%	%	Kin.	Kin.	%	%
Stripped ..	129380	17427	13·9	91·97	164409	20715	13·6	84·7
Unstripped	127093	17538	14	92·02	159960	20954	14	8·6
Difference.	+ 2287	— 108	·1	·05	+ 4449	— 239	·4	1·3

Average, 3368 kin of cane gained per cho by stripping canes.
,, 174 kin of sugar lost per cho by stripping canes.

(7) Calculating the results in average money value, 10·104 yen is the profit on the crop and 13·92 yen the loss in manufacture per cho, the difference being 3·816 yen (1 yen = 2·05s.). The cultivated cane lands now existing in Formosa amount to 35,000 cho, so supposing all the canes were stripped, the total loss would aggregate somewhere about 133,560 yen for the whole of Formosa last year simply by carrying out the practice of stripping the dead leaves.

(8) The juice obtained from all canes from which the dry leaves are not stripped is not inferior in its quality, but on the contrary has a slightly increased sucrose content and coefficient of purity.

"I have been engaged in financial work all my life. It is impossible for anyone responsible for the finances of the country to be popular if he wishes to do his duty." So declared Lord Cromer, in the course of a criticism of the reduction in the sugar tax, and a truer word was seldom spoken.

THE UTILITY OF BY-CROPS IN THE WEST INDIAN AND OTHER TROPICAL ISLANDS.

In an article entitled "The West Indies and their Produce," which appeared in this journal in May, 1905, the writer strongly advocated sweeping measures of reform in the administration of the West Indian colonies, the principal items of which included, 1st, the union of these colonies into a single confederation under one governor; 2nd, the establishment of a strong federal staff of scientists for the supervision of sanitation, afforestation, public works, &c., and for affording information to planters, manufacturers, &c.; and 3rd, for the initiation of a good educational system. It is now his desire to emphasize his former remarks, to review the progress that has taken place in the interval, and to make further suggestions which he trusts may ensue to the benefit of the parties concerned.

It is, however, much to be regretted that the Colonial Office has made no attempt to carry into effect the wise and statesmanlike recommendations made by Sir Robert Hamilton, whose report was presented to Parliament so long ago as 1894, first in regard to the riots in Dominica in 1893, and secondly with reference to reforms in administration, wherein he advocated the union of all the West Indian colonies under a single Governor, the appointment of an Inspector-General of Schools and of an Auditor-General and other minor changes by which unity in administration, education and finance would be secured. It is not intended at present to discuss further the political question (for the details of which readers are referred to the former article) beyond urging the creation at an early date of a strong scientific staff (whose services should be available to all these colonies) to superintend public health, public works, afforestation, and the general well being of the land and its inhabitants, the utility and the wise economy of which must be obvious to the meanest capacity.

Until the last few years the staple crop in the West Indies was sugar only, and the term 'by-crops' or 'by-products' is here used to denote all vegetable tropical produce except sugar and its derivatives. Although in the past other crops were neglected in favour of sugar or grown only to meet local requirements, and although the former state of things is passing away, it is expedient notwithstanding to urge strongly the adoption of a policy calculated to bring under tillage the whole available soil of each island or district, rich or poor, mountain or marsh, according to the local capabilities.

There can be no doubt that the British sugar interest must if it desires to meet the European beet cultivators on equal terms move with the times. The last generation of planters who were at the same time growers of cane and manufacturers of sugar has nearly

died out, few of them were men of capital, and many were dependent upon advances from the merchants without which the crops could not have been planted at all. Now-a-days the West Indian planter must submit to take a lesson from his French neighbours in Guadaloupe (for instance) and confine himself to growing canes only for sale to the central factory. In essentials the system has prevailed on a small scale for many years among the small metayer cultivators who held land of the planter and carried their crops to his mill. The modern system of central factories possesses two great advantages, 1st, that the manufacture of sugar can be carried on upon a large scale with the best modern appliances, and 2nd, the cane grower is able to devote his whole time to the growth and improvement of his canes.

The meeting of the West Indian Agricultural Conference, 1908, must not be allowed to pass without notice as the discussions upon various details of sugar culture, manufacture and management are likely to prove of great value in the near future, and the reports of experts upon the newly introduced varieties of seedling canes seem to prove that their researches exercise a most important influence upon the industry in Guiana, Barbados, the Leeward Islands and elsewhere, and that the establishment of richer and more stable plants exempt from many forms of cane disease will greatly encourage the planting interest.

It may also be suggested that in the larger colonies it might be expedient to establish sugar refineries—the raw material being close at hand, rents and wages being low in comparison with those paid in Europe. Freights of course must be paid in either case, although it is probable that the carriage of the finished article will be cheaper and quicker than that of the half manufactured sugar, as dry and loaf sugar occupy less space and can be sent by the mail steamers while raw sugar can only be sent by the cargo boats.

It may here also be noted that the West Indian sugar farmer has a great advantage over the European beet farmer in that there is no winter to put a check on plant growth for a considerable part of the year, for in the tropics vegetable growth never ceases.* During the progress of sugar culture there are many intervals when the full service of the labour staff is not required, and at the period when De Lesseps was constructing the Panama Canal a good many of the black labourers were drawn off to the works. Now it is important that the full staff of labourers should be kept upon the estates, and the attraction that will keep them there is the knowledge that constant employment can be depended on. The raising of by-crops, that is crops other than sugar, will fill up the intervals of leisure and at the

* This is particularly noticeable in the case of the cotton plant, which is an annual in the Southern States of the American Union but is a perennial in the West Indies. The writer has seen plants in 1889 which were originally put in during the American Civil War and afterwards allowed to run wild, and has gathered cotton from them.

same time bring into cultivation a good deal of land by its nature and its situation unfitted for cane. In Montserrat, for instance, the writer has visited the coffee gardens of the Montserrat Co., running up to the top of the mountains, cacao gardens in sheltered spots, limes, arrowroot, and cotton in similar situations, the inaccessibility of which rendered them unfit for cane. It must by the way be observed that while the negroes in Jamaica, Barbados, Antigua, St. Kitts, Trinidad, and Demerara are on the whole steady workers, in some of the smaller islands where there are very few whites, the negroes are much less inclined to work inasmuch as they can raise enough to live in plenty with very little toil, look upon Haiti as an ideal, are rather jealous of the intrusion of white men and show their feelings sometimes in a rather unpleasant way.* This, however, is not usual, and could be got over by inviting the negroes to grow the produce required for sale in the open market while the Government supplied the necessary teaching in accordance with the precedent set by the Kingdom of Denmark in regard to the dairy industry. In fact no better example can be adduced than that of the Danes as to the course to be pursued by the Government, and the scientific staff already referred to ought to be extremely valuable in diffusing the necessary instruction. In some cases it might be expedient for the State to advance, in addition to the sums spent on public works, money for the construction of central factories (as has been done in Queensland), gins, cotton presses, &c.

Among the numerous plants and trees indigenous and capable of acclimatization suggested here as suitable to supplement the staple crop, viz., sugar, are first *Coffee*, which has been successfully grown for several years past, and was in the 18th century the principal product of Dominica, St. Lucia, and other islands.

Tea could also be produced on most of the mountainous islands. In the Mauritius enough is grown to supply the local demand.

Cacao is also extensively grown, but it will probably be found expedient to leave the cultivation in the hands of the black tenants, as white planters usually have to submit to a good deal of petty pilfering. It may be a question, however, whether factories for the manufacture of chocolate could not be successfully worked, the ingredients, cacao, sugar, and spices being all grown locally and labour cheap.

Cotton may be said to have come to stay, and thanks to the exertions of the cotton-growing associations the industry seems to be well established, as may be seen from the fact of so small an island as Montserrat having exported last year cotton to the amount of £50,000. *Tobacco* is also a very profitable crop; cultivated for domestic con-

* The owner of a cotton plantation in Tabago (an island of black small tenants) was obliged a few years ago to give up his undertaking as his works were twice burnt, no one knew how. However he took the hint and retired.

sumption all over the British West Indies, but only grown for export to any great extent in Jamaica; what would chiefly be required if grown for export in the other islands is technical instruction in curing and manufacturing. The weed itself is of a very good quality.

Cocoanut palms are very extensively grown, but with the exception of British Guiana, where more than 7,000 acres are under cultivation, are chiefly raised for local purposes. It does not appear that any attempt has been made to initiate a trade in the dried oil-bearing kernels, technically known as *copra*, which forms the principal article of export from Polynesia, although the trade is a profitable one. The tree does not require a rich soil nor much attention. In the Virgin Islands, the Bahamas, Barbuda, and the marshy districts of Antigua its cultivation might be considerably extended. Side by side with the cocoa palm, bamboo and eucalyptus might also be profitably introduced.

Camphor, again, is a tree the product of which is much in demand as a drug and especially in the manufacture of celluloids; it could be readily acclimatized and would probably pay well.

The numerous varieties of *India-rubber* bearing plants also grow nearly everywhere in the lesser Antilles, and it would in practice be easy to select those best suited to particular soils and aspects—the same remarks will apply equally to the *Balata and gutta percha* trees, which are fairly plentiful in Guiana, Trinidad and Dominica.

There are also numerous smaller articles such as arrowroot, papaw, pimento, vanilla pepper and other spices which could be profitably grown by the small cultivators if proper instructions were given.

Limes are too well known to need further mention, but a trade in oranges could be developed, and consignments from Dominica have been sold in London at a good profit and early in the season.

Afforestation.—In view of the growing demand for timber, which is year by year becoming more acute owing to the reckless felling of trees in America and elsewhere without replanting, it behoves the West Indian colonies to use their utmost exertions not merely to preserve their forests but largely to increase them wherever practicable, and a federal forest department (part of the scientific staff already referred to) should be organized with as little delay as possible to carry out these views as the demand for timber is constantly increasing in a greater ratio than the supply. In British Guiana, Honduras, and Dominica the forests are no doubt very extensive, but while intelligent inspection and regulation would probably be sufficient in their case it must not be forgotten that the forests will furnish a large and increasing revenue. It must also be remembered that the tropical woods have a great superiority over those of the temperate zones—as the timber grows much faster where there is no frost to check it. Also that by judicious management of the forests, especially by planting the watersheds,

the available water supply can be increased materially, and in a country which has to import coal, water power easy of access may make all the difference between success and failure in many business undertakings.

Trinidad and Jamaica could probably largely increase their acreage in timber while many places, such as the marshy part of Antigua, the mountainous district in St. Kitts (formerly forest), Barbados, the Virgin Islands, and the Bahamas would probably if carefully planted and managed bring in a large revenue. Individual growers of sugar, cotton, &c., might also interest themselves in tree planting.* It is just as easy to plant profitable trees such as logwood, india-rubber and balata trees, sandal wood, &c., &c., for ornamental purposes, wind screens, boundaries, &c., as trees of inferior value such as the silk-cotton and others of little value.

Wind-power in the islands where the trade winds blow nine months in the year is also not to be despised, especially as it can be converted into electrical currents and transmitted and stored when and where required.

It now remains to make a short resumé of the progress of the colonies during the last three or four years, beginning with

British Guiana.—This colony roughly comprises 75,600,000 acres, of which about 142,000 are under cultivation, i.e., less than 1 in 500. Sugar accounts for more than half the above acreage; but there is a large amount of rice grown, some cocoa palms, and a little coffee and cacao. The interior districts produce a little timber, about 400,000 lbs. of balata, about £300,000 worth of gold, and a few diamonds. There ought to be a great future before British Guiana, which is capable of supporting a population at least ten times its present amount of 300,000. With the aid of railways and the abundant water carriage and water power that it possesses, its output of sugar and rice ought to be trebled; the forests with judicious management ought to produce a large revenue, rubber can be extensively grown, a trade in copper established, and cotton, coffee and cacao culture extended, and the extensive savannahs of the interior thrown open to cattle ranching. Labour could be provided for all these objects by the importation of Indian coolies without difficulty.

Jamaica with its numerous by-products, such as tobacco, logwood, fruit, spices, &c., in addition to its sugar industries, can take care of itself. There is some scarcity of labour, but time and prosperous markets will attract a sufficient supply. It may be noted that the

* The advice of Dumbiedikes *père* in chap. 8 of the "Heart of Midlothian" is very much to the point: 'Jock, when ye hae nothing to do, ye may be aye sticking in a tree—it will be growing, Jock, when ye're sleeping.'

smaller tenants and metayers* now plant cane in considerable quantities for sale to the larger sugar works. There is room for improvement and extension in forestry. The roads are good and with the railways provide sufficient means of communication. The shipping trade is prosperous, and the loss caused by the late earthquake at Kingston was confined to that district only and has not affected the general prosperity of the island.

British Honduras is a colony much in need of development. Little more than one per cent. of the total acreage is under cultivation. The staple trade is in logwood and mahogany, but there is no reason why the raising of rice, tobacco, copra, rubber, fibres, &c., should not pay well. The water carriage is fairly good, but the roads are very poor. What is wanted is a good forest staff and better sanitation. There are also facilities for ranching in the Pine and Catroon Ridge districts, which are suitable for cattle.

Trinidad is one of the flourishing colonies, about 20 per cent. of its acreage being under cultivation. A large trade in cacao, sugar, pitch, &c.; labour, &c., plentiful; roads good, railways and large shipping trade; improvements in forestry desirable; very suitable for balata and rubber; copra also would prove remunerative.

The Bahamas have done on the whole very well when the scattered nature of the islands, the difficulty of communication, and the inferior soil are taken into account. The trade in fruit, fibre, and cotton would probably repay cost of development, and in some of the larger slands it would be desirable to plant timber, and especially cocoa nut palms with a view to copra. The sponge fishing, which has been for some years past in a declining state, would no doubt revive if modern and scientific methods of propagation were adopted. Fibre has been grown, but with what results it is not known.

The Leeward Islands.—Antigua is doing well in sugar, but there is room for improvement in other respects. About four out of every seven acres are in cultivation, but the remainder could certainly be made available, the hilly part for forest, the marsh for cocoa palm, and eucalyptus.† It is to be regretted also that a railway from St. John's to English Harbour has not been constructed, as it would substitute an easily accessible harbour for the present inferior one at St. John's, and could be made to pass also through the principal

* *Metayer*—a form of tenancy also called share tenancy, common in West Indies. The landlord lets so much land to tenant rent free and supplies him with cuttings for planting. The tenant cultivates the ground and takes crop to landlord's mill where the sugar is manufactured, the landlord taking from one-third to one-half the produce as per agreement, which usually contains a clause for eviction in case of careless cultivation, &c.

† The planting of eucalyptus would do much to mitigate the malarial fever for which Antigua is unpleasantly notorious.

sugar districts. Barbuda and the Virgin Islands would also be better if the planting of cocoa palms and timber were commenced; cotton and fibres would also succeed well. *St. Kitts* should also have the central high lands (formerly a forest) planted with timber—the marshy ground should be planted with cocoa palms and eucalyptus; the same remarks apply to Nevis. Dominica has perhaps the finest natural advantages in the Leeward Islands; good forest management and the conservation and employment of the abundant water power it possesses are what it chiefly requires. We are glad to hear that the railway to the Layou Flats which we advocated in our former article is likely to be constructed very shortly.

The Windward Islands, St. Lucia, St. Vincent, and Granada, are much alike in character. There is waste land and water power in abundance, and some timber; the suggestions as to the Leeward Islands are applicable *mutatis mutandis.*

Of *Barbados* there is little to say except that she has set so good an example that a better object lesson could not be desired.

In conclusion it can hardly be too strongly or too often impressed upon the reader the necessity that these or similar reforms should be carried out at the earliest possible date. In a very few years the Panama Canal will be in operation, and the volume of traffic which will flow through the Caribbean Sea and the Mexican Gulf cannot but have a most healthful and stimulating effect upon all the islands little and great—but if they are to benefit by this event they must be prepared and in readiness to make use of opportunities as they present themselves. Our own strong impression is that there is a good time coming in the near future for tropical countries, and especially the West Indies, but it is seldom that good things drop into the open mouth of their own accord. They have to be sought and worked for. *Verb. sap.*

One of the first arrivals of Russian sugar in this country since September 1st was a 1000-ton cargo of Russian crystals shipped via Dantzic to Greenock.

M. F. Sachs, the distinguished Belgian sugar expert, and editor of the *Sucrerie Belge*, has been the recipient of a well-merited honour, having been gazetted a Chevalier de l'Ordre de Léopold, no doubt in consideration of his services in connection with the Brussels Sugar Convention.

THE CENTRAL SUGAR FACTORY AT ANTIGUA.

In May, 1906, we gave our readers some particulars of the working of the Antigua Central Factory, including a copy of the first balance sheet of the concern. Since then further progress has been made, and it will be worth while setting on record in our pages the latest details as supplied by the Hon. Francis Watts, C.M.G., to the West Indian Agricultural Conference of this year. We therefore reproduce below his paper and the discussion which followed, for both of which we are indebted to the *West Indian Bulletin*.

"In the course of the proceedings of the fifth Agricultural Conference held at Trinidad in 1905, I was afforded an opportunity of placing on record an account of the Central Sugar Factory then in course of erection at Antigua. The nature of the machinery to be employed was stated, and the co-operative contracts under which the factory is worked were explained. It will be remembered that this factory was erected as a pioneer one, designed to solve the much debated question of whether it is desirable, under the conditions in the Leeward Islands, to abandon the muscovado method of sugar manufacture for the methods of modern factories. I am now able to state that three crops of sugar have been reaped, and the work of the factory has so far developed that it may be of service to those interested in the movement to have details as to what has been done.

Crops Reaped and Results.

"In 1905, the amount of sugar produced was 1634 tons from 15,860 tons of cane. One ton of sugar was therefore obtained from 9·70 tons of cane, or sugar at the rate of 10·3 per cent. of the weight of the cane. The sugar realized an average net price of £12 15s. 5d. per ton, and the price paid to the original contracting proprietors was 14s. 1d. per ton of canes.

"In the second season, that of 1906, 2348 tons of sugar were produced from 24,676 tons of canes. These figures work out at 9·52 per cent. of sugar on the weight of cane, or 1 ton of sugar from 10·5 tons of canes. The price paid to the original contracting proprietors for canes was 7s. 1d., with a bonus addition of 4d., making in all 7s. 5d. per ton of canes. Canes were also purchased from outside estates at 9s. 3d. per ton, and peasants' canes cost 7s. 8d. per ton. The season was one of drought, and it was difficult to obtain a sufficiency of water for maceration; hence the recovery of sugar from the cane was somewhat poor.

"In 1907, 4230 tons of sugar have been made from 40,782 tons of canes. This gives 10·37 per cent. of the weight of the cane, or a ton of sugar from 9·64 tons of cane. The price paid to the original contracting proprietors for canes was 8s. 7½d. per ton. To this was

added a sum of 1s. 4½d. per ton to bring the price for canes up to 10s. before division of profits was made, in accordance with the terms of the contract. On division of profits, a further sum of 2s. 3d. per ton of canes was paid, making the price paid for canes to original contracting proprietors equal to 12s. 3d. per ton. The proportion of sugar obtained in relation to the amount of cane must be said to be satisfactory, although it ought not to be the final word in respect to sugar extraction for this factory.

"The season of 1907 was the first in which a full supply of cane was forthcoming, and was also the first in which the factory principle may be regarded as being fairly exemplified in Antigua. The results would appear to be satisfactory. The factory, originally planned for a crop of 3000 tons of sugar, has turned out 4230 tons on the average of 1 ton of sugar from 9·64 tons of cane. At an average price of £9 16s. per ton of sugar the contracting proprietors received 12s. 3d. per ton of canes delivered, and have, moreover, an interest in the working of the factory. The factory now has an assured cane supply calculated to yield about 5000 tons of sugar in a moderately good season.

Financial Position.

In now becomes necessary to examine the financial position. The original capital of the factory was £40,000. This was, however, insufficient, for the first balance sheet, issued in September, 1905, showed a capital expenditure of £45,359 and a sum of £3383 involved as working capital, making a total of £48,742. The factory erected contained only two three-roller mills, but it was the intention from the first to put in a Krajewski crusher as soon as the capital could be liberated for that purpose. This crusher was added in time for the crop of 1907 and a material improvement in the mill work resulted.

"Further heavy expenditure has been incurred in the last two years in extending the railway. This extension involved the purchase of an additional locomotive. It increased the cane supply and will enable the factory to deliver its sugar at the wharves in St. John's without the troublesome carting which has been necessary up to now. The additional expense is amply justified as it promises to be immediately remunerative. The total length of the railway is now about nine miles.

"It has also been found necessary to make minor additions to the plant in order to accommodate crops in excess of the anticipated quantity. In this connexion, in addition to minor improvements, there have been added: a juice heater,* crystallizer, filter press, and three centrifugals. The machines, materials, and stores required for these additions have cost about £10,000. Of this, about £3500 have

* In the original plant, two juice heaters of a heating surface of 500 square feet each were included, and not two of 1000 square feet of heating surface each as mentioned in the *West Indian Bulletin*, Vol. VI., p. 62.

been already paid by being charged in the annual expenses of working; £3300 are added this year to capital account, and the remainder will appear as a charge in future accounts. We have thus an original capital expenditure of £45,359 and further capital expenditure of about £6800, making in all £52,159, exclusive of the value of stocks and stores of spare parts.

"The last balance-sheet shows total capital of £51,713 10s. 1d., but of this £8470 11s. 3d. is in the form of cash and amounts due.

"The net sum of £43,242 18s. 10d. is therefore left as the charge against the value of machinery. This is £9917 below its cost, and to this can be added £2684—the value of 'stocks, stores, and spare parts' on hand on September 30th, 1907. A gain, therefore, of £12,601 is shown—an amount that does not include bonuses paid to shareholders and cane growers.

"We can, however, obtain a clearer insight into the position of the factory and its gains by dealing with the items shown in the profit and loss accounts for the three years. The amounts paid off are as follows: The sum of £2000 has been written off by way of sinking fund in each of the three years, in all £6000; an amount of about £3500 has been paid out of annual working charges for extensions. That is to say, some £9500 have been already paid out of profits towards reducing the capital charges of the factory. In addition, two Government debentures, each of £1000, have been written off under the contract. These are amortized without payment and cannot be considered as a charge on profits.

"In addition to the sums of £9500 and £2684 above mentioned, the profits of the factory for equal divisions were in the first year, £3885 1s. 8d., and in the third year £6345 10s. 8d. In the second year, £331 17s. 10d. was paid to the original contracting proprietors, there being insufficient for division to make up the price of cane to 10s. per ton. To this must be added the sums of about £1920 required in this season to make up the price paid for original contracting proprietors' canes to 10s. per ton,* and also the £2000 carried to the reserve fund. In all, therefore, the *gross profits* of the factory for the three years of its working may be set down as £26,665, exclusive of interest on share capital but including the value of stores in hand.

DISTRIBUTION OF PROFITS.

"The factory being on a co-operative basis, we may inquire into the distribution of these profits. The original contracting proprietors have actually received in money in the first year £1942 10s. 10d., in the second £331 17s. 10d., and in the third £3172 15s. 4d., and £1920.

* The profit and loss account shows only a statement of 10s. per ton paid for original contracting proprietors' canes. As a matter of fact the payments were made in two stages; 8s. 7½d. being paid in the fortnightly payments, and 1s. 4½d. as an additional payment out of profits.

In all they received £7367 4s. over and above the sum paid as the value of the canes on the basis of the value of $4\frac{1}{2}$ lb. of 96° sugar per 100 lb. of cane. As the original contracting proprietors have, during the three years, delivered 62,274 tons of cane, the cash payments have been equal to 2s. 4d. per ton of cane, in addition to the payments on the $4\frac{1}{2}$ lb. basis. The price actually paid on the $4\frac{1}{2}$ lb. basis for the 62,274 tons is £28,501 1s. 5d. or practically 9s. per ton, which with the bonus addition of 2s. 4d. brings the average cash price paid for original contracting proprietors' canes for the three seasons to 11s. 4d. per ton. The A shareholders in the meantime have received in the aggregate £5115 6s. 2d. in addition to their interest of 5 per cent. per annum.

"But each party may be held to participate in those portions of the gross profits that have not been paid out in cash bonuses. An amount of £12,482 (£5115+£7367) has been paid as cash bonuses, and therefore £14,183 of the gross profits are left as having been invested in the factory. It will, however, be seen that no reference has been made to depreciation. During the three years there have been spent for repairs, maintenance, and extensions from current working account in the aggregate £7187 4s. 10d.; but of this, £3500 have been regarded as being on account of extensions and have been treated above. This leaves the sum of about £3687 as having been spent on repairs and renewals. This may be considered in the nature of expenditure on depreciation account, but should, however, be held to be an insufficient amount.

"Having regard to the conditions of the factory, and taking into account the manner in which repairs have been made, I think it will be ample to charge 5 per cent. on £50,000 for depreciation, that is to say, £2500 a year or £7500 for the three years. This sum may therefore be deducted from the £14,183 regarded as profits invested in the factory.

"The sum of £6683 is left, therefore, as profits invested in the factory after allowing for depreciation, and this sum may be regarded as belonging in equal moieties to the A shareholders and the original contracting proprietors, or £3341 to each party, or rather at the rate of 1s. $0\frac{3}{4}$d. per ton of cane supplied.

CONCLUSION.

"The position of the original contracting proprietors may be summed up in saying that they sold 62,274 tons of canes and have received £28,501, or 9s. per ton, by way of first payment; £7367, or 2s. 4d. per ton, by way of cash bonuses, and have invested £3341, or 1s. $0\frac{3}{4}$d. per ton of cane in the factory. The A shareholders have received 5 per cent. interest on their money and, in addition, cash bonuses of £5115 equal to 6·8 per cent. per annum on the capital

invested by them. They have therefore received 11·8 per cent. per annum in all, and in addition there is the investment in the factory of £3341 out of profits, equal to a further 4·4 per cent. per annum. It may be added that the factory has made, during the three years, 8214 tons of sugar, which realized £81,682, or, on the average, £9 18s. $10\frac{1}{2}$d. per ton.

"It is interesting to note that, calculating the value of canes, on the basis of $4\frac{1}{2}$ lb. of 96° sugar per 100 lb. of canes on this price, it will be found that canes were worth 8s. $11\frac{1}{2}$d., a figure practically identical with the actual price paid by way of first payment. It is also worth noting that, if 9s. per ton of cane is the equivalent of $4\frac{1}{2}$ lb. sugar per 100 lb. of cane, the cash bonus addition of 2s. 4d. is equal to a further $1\frac{1}{6}$ lb., or 11s. 4d. is equal to $5\frac{2}{3}$ lb. of 96° sugar per 100 lb. of cane.

"While it is hoped, and anticipated, that future years' working may show even more favourable results, it must be remembered that the large interest on working capital is in a measure due to the fact that a portion of the capital invested bears no interest.

"These figures, I think, indicate a very sound financial position, and should prove useful to those who contemplate erecting similar factories."

DISCUSSION.

Hon. F. M. Alleyne (Barbados) enquired what it cost per mile to provide the railway lines belonging to the factory.

Dr. Watts replied that the lines, including rolling stock, cost about £800 per mile.

Hon. F. J. Clarke (Barbados) asked whether there were many outside the original contractors who sent their canes to the factory, and at what rate were they paid.

Dr. Watts replied that there were many estates which now sold their canes on a basis of $5\frac{1}{2}$ lb. of sugar per 100 lb. of canes, which worked out at a little under 11s. 4d. per ton, and they were perfectly satisfied to sell their canes at that rate.

Mr. T. W. B. O'Neal (Barbados) enquired whether the factory was a government one.

Dr. Watts replied that it was a co-operative concern. The Government gave the residue of the Imperial Grant-in-Aid to assist in the establishment of a central factory, and that remains as a lien against the factory. They were under the obligation, however, to purchase not less than a certain quantity of canes every year from the growers at not less than 7s. 6d. per ton.

The President stated that out of 6000 tons of crystals shipped from Antigua, nearly 2250 tons represented the gain due to improved methods of crushing and manufacture. He made that statement on the basis of information given him by Dr. Watts, and he should like Dr. Watts to give some explanation in connexion with it for the benefit of the Conference.

Dr. WATTS said that the relationship between the muscovado sugar industry and the sugar produced by the factory still remained an unsolved problem for the reason that they had never yet been able to get an adequate series of the weighing of canes for the whole of a crop on any muscovado estate. Every cane that went to the factory was weighed and paid for. Last year they got some figures from a muscovado estate which showed that it took 17 tons of canes to make 1 ton of sugar, while the factory took 9·6 tons of canes to make a ton of sugar. Allowing therefore a sufficient margin on either side, they might for purposes of calculation assume that whereas the factory might take 10 tons of canes to make a ton of sugar, the muscovado mills would take at least 16 tons.

Hon. F. J. CLARKE said that the conditions must be vastly different in Antigua from what they were in Barbados, because three years ago when the figures in connexion with the Antigua factory were published, some of the planters in Barbados took the trouble to weigh their canes, go into calculations and make comparisons with the figures of the Antigua factory. They found that with their muscovado process they did very much better than that factory and had realized fully 14s. a ton for canes. He had been furnished with statistics by several planters who weighed their canes, and in every case they had found that they would have lost considerably by selling their canes to a factory at the prices paid at Antigua.

Dr. WATTS was of opinion that for the planter to get full value for his canes the factory must be worked on the co-operative principle.

The PRESIDENT pointed out that this point was specially emphasized in the Report of the Royal Commission, and until they could get a co-operative factory working in Barbados and owned by the people themselves, there was little chance of the aspect of things being materially altered.

Mr. G. ELLIOTT SEALY (Barbados) asked whether Dr. Watts was in a position to inform them what was the difference in the cost per ton of sugar or per acre of working estates in Antigua now that the canes were sent to the central factory.

Dr. WATTS said that was a question which one could not answer. It was a matter which concerned an individual so closely that it was not always prudent to ask too much as to what profit he was making out of his estate. He had never asked such a question of any planter, nor had he ever been supplied with information that would enable him to answer the question whether the clearance per ton of canes on a plantation manufacturing its own sugar was greater or less than that on a plantation selling its canes to the factory. He thought he could venture to say, however, that the saving on a plantation supplying its canes to the factory was greater than was anticipated.

Hon. B. HOWELL JONES asked whether the canes should not be paid for by contents, rather than by weight, as the sugar-content of the juice of the sugar-cane varied considerably.

Dr. WATTS thought that so far satisfaction was felt as to buying canes by their weight.

A PATENT INTERLOCKING GEAR FOR WATER-DRIVEN CENTRIFUGALS.

Most engineers who see an installation of water-driven centrifugals for the first time are struck by the apparently large size of the Duplex pump usually supplied to an installation of this kind for providing the necessary water power. Experience has shown that this type of pump cannot run with efficiency at a high piston speed, both as regards the amount of steam used, and the tear and wear of the parts. It has therefore been found advisable to make the pump of such a size that the piston speed will not exceed 75 feet per minute under maximum working conditions.

As is well known, the power required to accelerate a centrifugal machine to full speed quickly is much greater than is required to maintain the centrifugal at full speed, consequently each centrifugal is provided with two water jets, a large one and a small one. When starting the machine, both jets are required, but when full speed is reached the small jet only is needed to maintain it. It sometimes happens that when the centrifugals are working intermittently all the machines may be accelerating to full speed at the same time, thus absorbing an amount of water largely in access of normal requirements. This is a reason why the pumps have hitherto been made so large.

With the object of arranging matters so that not more than half of the machines can be accelerated to full speed at one time and thereby reducing the size of the pump considerably without in any way reducing the output of the centrifugals, Messrs. Pott, Cassels and Williamson, of Motherwell, have devised and patented a new interlocking gear which they inform us operates as follows:—

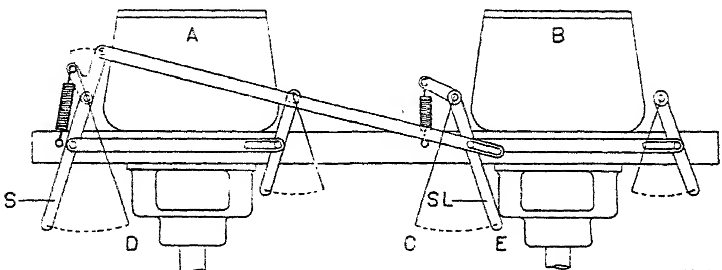
In ordinary practice, each pair of machines in an installation is interlocked, so that when one machine is started, the machine to which it is interlocked cannot be started until the first machine has attained full speed. When the latter reaches full speed, the accelerating jet is automatically shut off, and at the same time the starting levers of the other machine are released so that it may now be started. As the machines are usually arranged to accelerate in two minutes, and the cycle of operations will generally occupy at least six minutes, the interlocking gear, while not interfering with the output of the machines, ensures that they are worked in proper rotation. The advantages of interlocking will be evident from the following comparison of the maximum pump demand for a set of machines with and without the interlocking gear.

For instance, a set of machines which are interlocked in pairs, and which require a pump $9\frac{3}{4}$ in. diameter, would require a pump $12\frac{1}{4}$ in.

diameter when the machines are not interlocked (the maximum pump speed being the same in both cases). That is, without interlocking, the maximum pump demand is 55% more than when the machines are interlocked.

When a more rapid acceleration is required, three machines are interlocked, so that one of the three only can be accelerated to full speed at a time, in which case a pump 11¼ in. diameter would do the work, instead of a pump 17 in. diameter which would be required if the machines were not interlocked, an increase in this case of 130%.

It should be remembered that in most cases the steam cylinder is at least twice the diameter of the pump, and therefore the smaller the pump the smaller the steam cylinder.



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A and B represent the water motors of two centrifugal machines; A is accelerating to full speed, while B is locked so that the accelerating valve cannot be opened. With levers in position shown, the machine A is being accelerated, and therefore the starting lever S L, for the machine B, is locked and cannot be moved into the starting position C until the starting lever S, of machine A, is in position D, which position it reaches in two minutes. The machine being accelerated to full speed in that time, the governor automatically cuts out the accelerating jet. It will now be observed that in a similar way the machine A cannot be started until the machine B has been accelerated, and the starting lever S L, of the machine B, has automatically returned to position E.

The governor trigger rod which holds the accelerating lever in position, and which is automatically released by the governor when the machine attains full speed, is not shown in the illustration.

ALKALINE SOIL WATERS AND THEIR EFFECT ON THE GROWTH OF THE SUGAR CANE.

In the course of a paper on "Manurial Experiments in British Guiana," delivered before the West Indian Agricultural Conference last January, Prof. J. B. Harrison, C.M.G., took occasion to deal at length with one aspect of the problem of soil cultivation which has not hitherto received much attention, viz., that of soil hygiene. He considered that the lack of proper soil hygiene was one cause of the too frequent decrease in crop yields, a decrease which was often wrongly laid to the door of "root fungus." We have not space to give the whole of Prof. Harrison's paper; but we reproduce below a large portion of that section which deals with this particular question.

THE EFFECTS OF LONG-CONTINUED APPLICATIONS OF SULPHATE OF AMMONIA AND OF NITRATE OF SODA ON THE PRODUCTIVENESS OF THE SOIL.

During a third series of experiments with Bourbon canes (1901-04) the crops on the plots which had been highly manured with nitrate of soda showed well-marked signs of decrease in their yields as compared with those which had been highly manured with sulphate of ammonia, the latter being 43·7% higher.

When the plots were replanted for the 1905 crop they were all manured with sulphate of ammonia, and it was found that the increase due to manurings averaging 300 lbs. of sulphate of ammonia per acre was 8·9 tons of canes where sulphate of ammonia had previously been used, and 7·4 tons where nitrate of soda had been applied. The increases were therefore 20% higher on the land which had been manured with sulphate of ammonia for many years than on that which had been similarly dressed with nitrate of soda.

But during the growth of the 1904-5 crop, representations were made to Prof. Harrison by persons interested in the sugar industry of the colony to the effect that the marked falling-off which had been noticeable of late years in the productive power of some of the cane fields might be due to the effects of long-continued, repeated manurings with sulphate of ammonia, and was thus similar to what had occurred at the Woburn Experimental Farm of the Royal Agricultural Society, England, and to a less extent on certain of the Experimental Fields at Rothamsted. The soil of the former place is a light sandy one, but that of the latter is a clay loam. Where sulphate of ammonia has been used continuously at Woburn for between twenty and thirty years, the soil has been rendered absolutely barren for certain economic plants, whilst the evil effects of the long-continued

manurings (for fifty years and over) at Rothamsted with the same salt are now very perceptible.

Advantage was therefore taken in 1905 of the mode in which the experiments had been conducted, to arrange trial plots for examining into the question whether the use of sulphate of ammonia from 1892 to 1905 had been injurious to the soil of the experimental field, and whether better results would not be obtained by the substitution of nitrate of soda for sulphate of ammonia.

The previous manuring of the field allowed the following comparisons to be made with three varieties of canes on not-limed and on limed land:—

Sulphate of ammonia after sulphate of ammonia (fourteen years).
Sulphate of ammonia after nitrate of soda ,, ,,
Nitrate of soda after sulphate of ammonia ,, ,,
Nitrate of soda after nitrate of soda ,, ,,

These trials showed a mean increase of 9·75 tons of canes per acre by nitrogenous manuring on soil long manured with sulphate of ammonia, as compared with 7·25 tons on that which had been similarly manured with nitrate of soda—an increase of 34·5 % in favour of the sulphate of ammonia soil.

The substitution of nitrate of soda for sulphate of ammonia resulted in the increase being lowered from 13·1 tons of canes per acre to 6·4 tons. Much of this decrease, however, was due to the unfavourable meteorological conditions; the weather during 1907 was singularly unfavourable for obtaining satisfactory returns from nitrate of soda owing to the continuous heavy rains which occurred during some months after its application. The substitution of sulphate of ammonia for nitrate of soda on the plots long manured with the latter was attended by a mean increase of 3·1 tons of canes per acre.

The results obtained during the third series of experiments and during the three crops of 1905, 1906, and 1907 point to peculiarities in the soil which, whilst preventing any injurious action of the long continued application of sulphate of ammonia, had caused those of nitrate of soda to act detrimentally on it. In Prof. Harrison's opinion they indicate that in very heavy clay soils, such as those of the experimental fields, and under tropical meteorological conditions, the deflocculation or puddling caused by long-continued dressing with nitrate of soda is likely to prove more injurious to the productive power of the soil than is the souring action, either direct or indirect, of sulphate of ammonia.

The fact that during the first series of experiments (crops of 1892-6) the increase produced by each 10 lb. of nitrogen, where manurings of 400 lb. of sulphate of ammonia (= 80 lb. nitrogen) per acre were used, was 1·21 tons of sugar cane, whilst in the third series it was 2·01 tends to show that the long-continued applications of sul

ammonia, instead of injuring the productive power of the soil, have rather improved it.

In 1902-3, a series of determinations of the nitrogen and of the manurial constituents of plant food of ready availability as measured by their solubility in $\frac{1}{200}\%$ hydrochloric acid was made on this soil. But the results gave little if any assistance towards the solution of the problem.

It was therefore evident, that the changes which had taken place in the soil were not likely to be recognized by ordinary methods of chemical analysis.

It appeared to Prof. Harrison that these could only be ascertained by utilizing some process, natural or artificial, by which the results of the changes taking place in very large quantities of the soil and over prolonged periods, would be accumulated and concentrated.

These heavy clay soils are only surface drained. Subsoil drainage has been tried on similar soils in British Guiana on a large scale on several occasions and has invariably failed, owing to the great retentive power of the lower layers of the soil. For example, it was tried for many years on about 20 to 30 acres of the Botanic Gardens, where it was a complete failure.

Water which slowly percolates through the upper layers of the soil accumulates at and below the level of the water-table. Where the water-table is near the surface, during each prolonged dry season, some of this water is brought up by capillary action into the upper and cultivated parts of the soil and is there subject to concentration by evaporation. At the commencement of the rainy season this concentrated water is driven down in advance of the slowly percolating rain-water—in a manner well known to every soil analyst—and thus the soil-water tends to become more and more concentrated at the level of the water-table. It appeared that examinations of this naturally concentrated soil-solution would possibly assist in the elucidation of the problem.

During the dry season of 1907, Prof. Harrison caused holes to be dug in several places in the experimental fields. It was found that at depths of from 4 to 5 feet the soil was saturated with water, and at the level of the water-table, when the holes were sunk a few inches lower, water gradually accumulated in them. As a general rule, in from 12 to 24 hours they were able to collect from about ½ to 1 gallon of soil-water from each of the holes.

The first holes were put down in a rice field, and preliminary examinations showed that the soil-water was markedly alkaline. The other holes were sunk in the Botanical Gardens, and in various ortions of old and new cane fields, both limed and not limed, al lots manured with nitrate of soda and sulphate of ammc for ively. ed

Determinations of the more important constituents were separately made in each of these samples, and the means were taken as representing the nature of the soil-water characterizing the soils under their conditions of cultivation. The general agreement in composition was found to exist in the samples from the various similarly treated paths and plots, but as was expected, differences in the degree of concentration of the soil-waters were more or less marked. For the determination of the general composition of the soil-waters, composite samples were made by mixing equal proportions of the waters from the holes in similarly treated places, and these—eighteen in number—were submitted to more exhaustive examinations.

The analytical examinations were made by well-known methods which it is unnecessary to detail here. The temporary and the permanent alkalinity were determined by using methyl orange as the indicator.

These analyses revealed chlorine and bromine which were derived either directly or indirectly from sea-water. In part they may have been in solution in the brackish water which at one time covered the area concerned, but in part they must have been derived from the sea-salts which are carried from the ocean in spray by the wind and are brought down to the land in solution in rain water. To decide whether these salts had been solely derived from sea-water or not, some comparisons were made in which the various ions present in the soil-water from the uncultivated and cultivated land in proportion to their contents of chlorine taken as 100 were compared with the ions of sea-water.

For every 100 parts of chlorine in the sea-water from which certain of the ions were derived, the soil-waters from not-cultivated land show an excess of 10·62 of the sulphate ion, of 11·00 of the carbonate ion, of 3·84 of calcium, and 9·85 of sodium, with a deficit of 0·28 of bromine, 0·15 of magnesium, and 0·84 of potassium. The soil-waters from cultivated land show an increase of 8·84 of the sulphate ion, 15·56 of the carbonate ion, 0·58 of iron, 6·00 of calcium, 2·32 of magnesium, and 4·69 of sodium, with a deficit of 0·28 of bromine, and 0·58 of potassium. Hence it is clear that the soil-waters are materially different in their contents of dissolved ions from diluted sea-water.

This shows generally that there is a considerable excess of sulphates and carbonates and of calcium and magnesium in the soil-waters over those present in sea-water; whilst the soil-waters from cultivated land show a marked increase in the proportion of carbonates over those of the water from the not-cultivated land.

If it is assumed that the ions in the soil-waters are combi-
together in the manner frequently adopted in statements of a
of water, the soil-waters would have to be considered as so

the bicarbonates of calcium and magnesium in water containing also in solution magnesium sulphate, magnesium chloride, and sodium chloride; the relative proportions of carbonates in the water from the not-cultivated and the cultivated soils being in round figures as 10 to 14. When the bicarbonates are dissociated and the excess of carbonic acid is driven off, we should expect the waters to be practically neutral in reaction, or rather somewhat alkaline, but only to the extent to which calcium and magnesium carbonates are soluble in saline water of this character. But on such dissociation a far more complicated change takes place. The alkalinity of the soil-water is equivalent to 19·9 parts of calcium carbonate per 100 parts of chlorine in the waters from the not-cultivated soils, whilst in those from the cultivated soils it is 25·9. But when the waters are carefully boiled so as to drive off the carbonic acid without allowing concentration by loss of water to take place, the alkalinity is only reduced to the equivalent of 10·0 and 15·1 parts of carbonate of calcium respectively.

The composition of the precipitated carbonates was determined in several cases, and they were found to consist of calcium and magnesium carbonates in approximately molecular proportions. The residual water was in every case markedly alkaline.

This is in accordance with the results obtained by others when working on saline waters of complex composition. The solids contained in solution in the water do not split up on either rapid or slow evaporation simply into insoluble carbonates and soluble alkaline salts, but certain proportions of the calcium and magnesium present are deposited as carbonates, whilst the rest of the solids remain as salts in solution. The calcium apparently remains as sulphate, and as chloride; the magnesium as sulphate, chloride, and carbonate, whilst the sodium and potassium appear to be present in part as sulphates, in part as chlorides, and in part as carbonates

That this is essentially what takes place during the gradual evaporation of the soil-waters Professor Harrison has proved by several experiments; and it is, in his opinion, to the production of carbonate of soda and of the soluble double carbonate of magnesium and sodium that the injurious effects on plants of the concentrated soil-waters are largely due. He and his staff examined eighty-seven samples of soils from various parts of the colony which were taken during the dry season from fields the soil-waters of which were more or less alkaline, and they found that the watery extracts from these soils were all alkaline to litmus paper, and so proved that the alkalinity was due to the presence of sodium carbonate and of the soluble double carbonate of magnesium and sodium. Thirty-eight of the soil-extracts were markedly alkaline, thirty-three alkaline, whilst sixteen were only slightly alkaline.

The Effects of Cultivation and of Manures on the Composition of the Soil-waters of the Sugar Cane Experiment Fields.

The mean results of the examinations of the soil-waters from the plots on the long-cultivated manurial experiment field (South Field) which has been in sugar cane since 1891 are worth consideration. Reduced to a basis of 100 parts of chlorine, they are as follows:—

	Not cultivated.	Cultivated, not manured.	Cultivated, manured with Sulphate of ammonia.	Cultivated, manured with Nitrate of soda.
Chlorine	100·0	100·0	100·0	100·0
Sulphate ion (SO_4)	14·5	18·6	19·6	19·2
Carbonate ion (CO_3)	13·6	15·5	17·7	18·0
Iron	..	..	..	1·1
Calcium	4·6	7·2	12·4	9·8
Magnesium	7·1	10·4	5·8	7·0
Potassium	2·6	2·0	1·2	0·6
Sodium	62·2	53·7	60·7	60·8
Total	204·6	207·4	216·8	216·5
Temporary alkalinity	10·8	10·3	10·7	8·6
Permanent "	12·5	16·2	20·3	20·8

The temporary alkalinity is given in terms of calcium carbonate, and the permanent alkalinity in terms of sodium carbonate.

These results afford few indications, as shown by the composition of the soil-water, that the cause of the falling-off in yields on the plots manured with nitrate of soda is due to any specific action on the soil. We have an increase in the permanent alkalinity of the soil-water by cultivation, and by manurings with both sulphate of ammonia and nitrate of soda similar to that pointed out in the consideration of the whole of the results.

The most noticeable point is that the relative proportions of magnesium to calcium in the soil-waters from the non-cultivated soil and from the non-manured soil and from that manured with nitrate of soda, the two latter being the soils on which the yields have markedly fallen off in late years, are very different from those in the soil-waters from the soils long manured with sulphate of ammonia. Taking the amounts of calcium present as unity, we get the following molecular ratios:—

	Calcium.	Magnesium.
Not cultivated	1	2·57
Not manured	1	2·40
Nitrate of soda	1	1·52
Sulphate of ammonia	1	0·77

Whether there is any signification in these ratios must be subject of further inquiry.

On another field which had been under cultivation for six crops only there was a noticeable increase in the permanent alkalinity of its soil-water on the parts cultivated but not manured, and cultivated and manured. The molecular relationships of calcium to magnesium are however very different to those recorded as existing in the soil-waters of the longer cultivated field. They are:—

	Calcium.		Magnesium.
Not cultivated..	1	....	1·39
Cultivated, not manured	1	....	3·26
Cultivated and manured with ammonium sulphate	1	....	3·18

The Relation between the Temporary and Permanent Alkalinity of the Soil-waters.

The proportions of the temporary and permanent alkalinity appear to be somewhat obscurely connected with the relationship of the numbers of the molecules of chlorine and of the sulphate ion to those of the carbonate ion present in the water. An increase in the relative proportion of the latter ion appears to be accompanied generally, though not always, by an increase in the proportion of permanent alkalinity.

The Proportion of Nitrogen in the Soil-waters.

It is noticeable that the contents of nitrogen in these tropical soil-waters are distinctly lower than is usually reported as characterizing drainage-water from cultivated land in temperate climates. With exceptions pointed out, the nitrogen in the soil-water other than that possibly found in organic compounds is entirely, or almost entirely present as nitric nitrogen, and it is evident, therefore, that nitrification takes place completely in the heavy clay soils of British Guiana.

The Concentration of the Subsoil Water in the Soil.

The examination of over 100 samples of heavy clay soils from various plantations of British Guiana and of their subsoil waters has shown that when the subsoil water is markedly alkaline and the alkalinity largely permanent, during dry seasons, the surface soil becomes more or less strongly alkaline. It is evident that during dry seasons the subsoil water is drawn into the layers of the soil by their capillarity, and there undergoes evaporation with attendant dissociation of the bicarbonates present in it, and the soil becomes more alkaline than is desirable. Examination proved that the excessive alkalinity of the soil during the dry season is due to soluble carbonates—carbonates of sodium, and the double carbonate of sodium and magnesium.

In order to ascertain if concentration of the subsoil water takes place [in the] upper soil during dry seasons, a series of holes was dug near

to the places whence samples of soil-water had been already collected, on various plots on the South Field down to the water-table, and samples of water collected from them. The former samples had been taken during a long spell of rainless weather, the latter were taken two or three days after heavy showers yielding from 2 to 3 inches of rain had fallen, and the level of the water-table had risen several inches. These showed that concentration had taken place and that the concentrated water had been driven down by and in advance of the newly fallen rain-water.

Examinations of several series of soil-waters collected from the level of the water-table during the wet season at the experimental field and on several sugar cane plantations proved that when the wet season has well set in, the water-table rises to from 2 feet to 2 feet 6 inches below the surface, and that its water then is of very low concentration, containing only 5 parts of chlorine per 1,000,000 whilst, although it is in fertile soils invariably faintly alkaline, its alkalinity is represented by only about 17 parts of calcium carbonate in 1,000,000, and is practically only due to minute amounts of that substance in solution.

SUMMARY.

Professor Harrison's summary of his investigations and of the deductions he draws therefrom is as follows:—

"It is very noticeable that on many long-cultivated heavy clay soils in British Guiana, soon after the dry season sets in, the plants on them hang back in their growth, and that later they wilt and their foliage becomes burnt. This takes place while the subsoil at depths of a few feet is saturated with water, and whilst the layers of the soil proper only a few inches from the surface are, as regards their contents of moisture, in a condition which should ensure the supply of water requisite to keep the plants in a healthy condition of fairly active growth through a considerable part, if not all, of the dry season.

"I have received many samples of soil-water from plantations which are under the charge of members of the Sugar Cane Experiments Committee of the Board of Agriculture of British Guiana. Nearly all of these are alkaline, a few—five out of ninety-eight—being faintly to markedly acid. Several of the alkaline samples were taken from fields on which planters have been compelled to abandon the cultivation of sugar cane, fields which once were very fertile but are now economically barren. These samples as a rule are very markedly alkaline, and the alkalinity is to a great extent of the permanent type, which remains after the dissociation of the carbonates.

"The injurious effects of dry weather on certain soils seems to be more noticeable now than it was some years ago. This may be in part explained by the increasing contents of the soil-waters

injurious substances, but in part it is doubtless due to the gradual impoverishment of the soil in humus-like constituents.

"Soil-waters of the sort now being discussed, containing high proportions of ions which may exist in combination as carbonates of iron, calcium, magnesium, and sodium tend to the formation in the lower layers of the soil or in the subsoil of a hard pan, more or less impervious to water, and above which the earth gradually becomes saturated with concentrated solutions which are injurious to plant-life.

"I have, personally, never favoured the readiness so apparent of late years to refer almost every instance of decreased yield in cultivated plants to the noxious action of microbes or fungi. It appears to me that for a long time back we have in the tropics rather neglected what I may term the physical and chemical hygiene of our cultivated soils, and have not paid sufficient attention to the soil-conditions which may have materially reduced the naturally resistant powers of plants to the attacks of bacteria and fungi. I am inclined to think that in many instances where 'root fungus' is invoked without scientific demonstration of its presence, in explanation of lessened crop yields, the lowering of the crop is due far more to unfavourable hygienic soil-conditions produced by long-continued cultivation, perhaps with little or no utilization of subsoil drainage and of the subsoil plough, than directly to fungus attacks. And further, I think that the susceptibility of certain kinds of plants, for instance, the Bourbon cane, to injury by drought and by fungus attacks is due in part at least to the defective conditions of soil-hygiene under which in places they are now cultivated.

"Of course, these detrimental conditions are far more liable to occur on very heavy clay soils which it is practically impossible to drain by subsoil drains than they are on many of the soils of the West India Islands, which have, or are reputed to have, efficient subsoil drainage. But I have seen in Barbados, in Trinidad, and in Antigua, soils giving low returns, which unsatisfactory results may, in my opinion, be due to neglect of soil-hygiene, especially with regard to deep drainage. In these cases I should suggest examination of the nature of their subsoil water as collected at the levels of the water-table.

"The practical deductions from the foregoing examinations may be summarized as follows:—

1. That the general reaction of fertile heavy clay soils in British Guiana is, as a rule, slightly alkaline.

2. That this slight alkalinity may be one of the reasons why sulphate of ammonia usually gives better results than does nitrate of soda when these manures are applied in heavy dressings.

3. That the alkalinity enables nitrification to take place readily in the soil during the existence of favourable meteorological conditions.

4. That the alkalinity, replenished as it is by that of the soil-water brought up capillarily during dry seasons, enables sulphate of ammonia to be used year after year without injuring or souring the soil.

5. That the alkalinity of the soil-waters is increased by cultivation and its attendant increased plant-growth, and apparently also by the action of chemical manures on the soil.

6. That in the course of long-continued cultivation the permanent alkalinity of the capillary water of the soil tends to become excessive, with consequent falling off in the crops.

7. The marked alkalinity and the high contents of salts of magnesium and of sodium chloride of the ascending subsoil water act detrimentally on growing crops during dry seasons and may be the cause of much of the cessation of active growth, of the wilting, and of the burning of crops soon after the commencement of and during dry seasons.

8. The alkalinity of the soil-water as far as it is not due to dissolved calcium carbonate tends to act detrimentally on the flocculation of the heavy clay soils, and, when assisted by the alkali set free from dressings of nitrate of soda, tends permanently to reduce the productivity of the soil where the latter substance is applied in large quantities continuously as a manure.

9. That possibly some of the readiness with which certain varieties of tropical plants, which have been under intensive cultivation for many years, now appear to fall victims to drought and to fungus attacks is due to defects in the soil and in the soil-waters, the results of long-continued cultivation without adequate deep drainage.

10. The application of heavy and repeated dressings of gypsum seems to be advisable on land, the subsoil water of which shows permanent alkalinity to a marked extent. Possibly the use on such land of concentrated superphosphate of lime in place of ordinary superphosphate or of slag phosphate may prove to be advantageous.

"In conclusion I trust that the results of my studies of the composition of soil-waters from lands under sugar cane cultivation in British Guiana may direct the attention of chemists and mycologists to the importance of studying the hygiene of the soil on which crops are raised, as well as the life-histories of the microscopic organisms which prey on them whilst growing."

THE CARBONATATION OF BEETROOT JUICES.*

By Eug. Stuyvaert.

(*Continued from page 453.*)

V.—The First Carbonatation.

Operating the Carbonatation.—The defecated juices are next submitted to the action of the carbonic acid gas. At the commencement of the operation the valve controlling the entrance of the gas is only partially opened so as to avoid excessive frothing as much as possible. When the gas is first turned on frothing is always greatest, and if by accident too great an amount has been admitted and there has been a too abundant frothing it will be necessary to use a froth-arrester, or else remove the froth into a separate vessel. After a few minutes the passage of the gas becomes more difficult, and the valve is slowly opened further, the formation of too much froth being all the time guarded against. At the end of a certain time, varying with the rapidity of the carbonatation, samples are taken. As the carbonatation continues the froth diminishes and the juice loses its viscoscity; decantation becomes gradually better, until when the action of the gas has been about sufficient, a sample, usually taken in a long spoon, has a precipitate which readily deposits and leaves a supernatent liquor having a fine amber-yellow tint. The spoon test enables the workman to judge of the progress of the operation by the appearance of the liquid, and to indicate the approach of the desired point of saturation. It is, however, very advisable to control the working by the more accurate means afforded by a series of chemical tests.

In order to give a first carbonatation juice of such a quality that it filters well, and that no sugar remains in it in an insoluble condition, it is necessary to stop the carbonatation at a certain alkalinity, which must not be too great to hinder filtration and thus induce a loss of sugar. If, on the other hand, all the lime is eliminated, that is to say if the juice is supersaturated, certain precipitates redissolve and the juice is left badly decolorized. In practice it is found that the best alkalinity for normal juices of mean density is about 1 grm. (calcium oxide) per litre; for lighter juices this figure can be lowered, and raised for those more dense.

In certain cases, principally when the scums contain appreciable amounts of sugar in the insoluble state, the carbonatation should be continued further in order to decompose the insoluble calcium sucrate; the causes of the formation of the insoluble compound must, however, be investigated.

* Contribution to the *Manuel de la Fabrication de Sucre de Betteraves*, edited by the ...iété Technique et Chimique de Sucrerie de Belgique. Translated by special ...ion.

Care of course, should be taken that the sample used for the determination of the alkalinity represents the average composition of the juices, and for this purpose the carbonatator should be provided with an agitator ensuring the proper mixing of the liquid. When open carbonatators are used the sample is sometimes taken with a spoon, and this method is not to be recommended. Most carbonatators are provided with small cocks placed about the middle of the height of the column of the juice in the tank or the sample may be taken by means of a special appliance.

For the determination of the alkalinity it is necessary to have the following apparatus: a graduated burette to contain the standard acid, a pipette to measure the volume of juice for titration, an indicator, a porcelain dish with a glass stirrer, and a filter to obtain clear liquid from the juice.

In first carbonatation juices, either phenolphthalein or rosolic acid, may be used as indicators of the neutrality. Both of these give results fairly concordant and approaching very closely to the truth; the former, however, usually gives results a little lower than the other.

The alkalinity is generally expressed in terms of lime, although in certain juices it is present only in traces.

It is convenient to use standard acid of such a strength that 1 c.c. neutralizes 2·5 mgs. of CaO. If, for example, when using acid of this titre 11 c.c. are necessary to neutralize 25 c.c. of first carbonatation juice, the alkalinity will be $(11{\cdot}0 \times 0{\cdot}0025 \times 40) = 1{\cdot}10$ grms. CaO per litre.

Carbonatation Tanks.—The treatment of the defecated juices with carbonic acid is carried out in special tanks; these must be designed to give the best conditions for a rapid and efficient carbonatation and a satisfactory utilization of the gas. At times frothing is so excessive that the workman is obliged to temporarily shut off the valve, and it is therefore desirable to provide the tank, as far as possible, with means whereby a continuous operation is performed.

The old type carbonatators were somewhat low, and it was often necessary with these to resort to steam or some oily substance for the destruction of the froth. Steam for this purpose is objectionable for the juices are diluted, and the use of grease or oil causes trouble with the filter-presses. At the present day, space is allowed for the froth; it is found in practice that the height of the carbonatator above the level of the juice contained in them should not be less than 3–3·5 metres, and that this is the best means of avoiding difficulties arising from this cause. The column of juice in the vessel above the distributor should be high enough to give the best possible utilization of the gas; this may vary from 1·5–3·0 metres. On these principles sometimes carbonatators are constructed with a total height of more than 7 metres; generally, however, it is considered the vessel should be designed to give a height of juice of 2·0–2·5 metres, with a free

height of 3·0–3·5 metres, giving a total height of 5–6 metres. In carbonatators of this type the utilization of gas is good, provided the distributing apparatus is satisfactory, and with normal juices froth arresters are superfluous if the operation is conducted from the commencement in a rational manner.

The form of the tank may vary; sometimes it is made square or rectangular, or again it may be cylindrical, according to the space at disposal. The general type is closed on top and the excess of gas is conducted through a chimney. The bottom of the vessel is either in the form of a pyramid or it is slanting towards the emptying valve.

For the heating of the juice undergoing carbonatation steam coils are sometimes used, but they readily become incrusted and it is then necessary to use high pressure steam, which is both slow and uneconomical. Some technologists prefer to use live steam injectors, but this again is unsatisfactory for the juices are thereby diluted. It is well to provide the tank with an agitator in order to ensure a good utilization of gas and a proper mixing of the juice for the purpose of sampling.

Gas Distributors.—Considerable attention has been devoted by engineers to the design of a means of distributing the gas throughout the volume of the juice so as to give its best possible utilization, and some very satisfactory results have been obtained in this direction. Some forms of apparatus distribute the gas well, but their gas passages become clogged after a short time of use.

The question of the economical utilization of the gas is of some importance. The co-efficient of utilization of carbonic acid gas varies considerably with different works. A defective utilization is not always to be traced to the distributing apparatus but may be due to an insufficient depth of liquor in the tank.

Iron tubes perforated on their surface are very much used especially for square or rectangular tanks as devices for injecting the gas. The smaller the openings in these and consequently the smaller the bubbles of escaping gas, the better will be the utilization; the inconvenience of the holes becoming obstructed however is increased.

Froth Arresters.—The formation of froth during the first carbonatation is unavoidable, but the workman should endeavour to prevent it as much as possible by a careful manipulation of the valve at the commencement of the operation, and by afterwards regulating it according to the tendency of the juice to froth. Steam *emousseurs* consist simply of tubes, 25-30 mm. in diameter, furnished with numerous perforations and fixed a short distance above the level of the liquid; through these tubes live steam is projected on the surface of the juice undergoing carbonatation in the form of a sheet steam breaking in this way the froth formed. In some works carbonic acid gas or compressed air is used in the place of steam; the former is inconvenient for when it is necessary to use a large quantity it causes the supersaturation of the upper layers of the juice.

Oils and fats were formerly in general use as froth arresters and at the present day are still much used for the purpose. It was usual to introduce these into the carbonatation tank by means of a spoon; this somewhat primitive method has been superseded by others which ensure a more economical use of the substance. The general principle of the apparatus having this object in view is to throw the oil or fat in a finely divided condition on the froth by means of a tube provided with numerous very small perforations, the necessary pressure being supplied by means of a small pump or by live steam which also serves to melt the fat. When oils or fats are used for the destruction of froth, preference should be given to one having a high viscosity, such as tallow or castor oil.

Various mechanical appliances are used to break the froth. The best known and simplest of these consists of a number of arms arranged in helix form to which a rapid rotatory motion is given. This apparatus is placed a little above the level of the juice, and when set in motion from a shaft cuts up the froth and destroys it.

The best means, however, of avoiding the annoyance and expense of using the above-mentioned methods of destroying or arresting the formation of froth is, as we have already said, to provide the tanks with a sufficient enlargement to prevent overflowing.

Irregularities of Carbonatation.—The irregularities of carbonatation which occur more or less frequently during the course of working can have very varying causes, the exact determination of which is often very difficult in practice.

With slow carbonatation the general work of the factory suffers, and inferior quality juices invariably result. It is, therefore, interesting to discuss the causes of this source of difficulty and to discover, if possible, the means of its remedy.

It may sometimes be caused by an excessive liming of the juice, by an insufficiency of carbonic acid gas, or again by the nature of the juice. These different causes are far from having the same results from the point of view of the quality and purification of the juice. The first may be occasioned by accident, and we again emphasize the importance of placing the operation in the hands of a reliable workman, and of exercising a careful chemical control.

The most frequent cause of slow carbonatation is an insufficiency of the amount of carbonic acid gas or a defective utilization of it. This can result from an impure gas being used either by improper working of the kiln or by the entrance of air through faulty connections in the pipes or washers. An insufficiency of gas for a carbonatation of normal duration can be due in part to the pump itself. Its satisfactory delivery under normal conditions of working can become quite insufficient when a poor quality gas is being used. It is therefore advisable from the commencement to instal a gas pump of ample size and capable of variation according to the condition of the kiln or the

occurrence of faulty joints. Cooling of the gas may also account to some extent for a slow carbonatation; it causes a reduction of the quantity injected into the juices, and this is of course the greater the higher the temperature of the gas.

When the working of the kiln and pump are both normal it is possible even then to have a slow carbonatation; this might be caused by the holes of the distributors being stopped or by the chimney being clogged with lime deposits.

Slow carbonatation can again be caused by the nature of the juice. When unripe or altered roots are worked a faulty carbonatation accompanied by a considerable formation of froth almost invariably results. This can be corrected to a certain extent by modifying the process of extraction, *i.e.*, by diffusing rapidly and at a lower temperature than usual.

The rate of carbonatation is influenced more or less by the conditions of defecation. It is generally agreed that a juice requires a longer time to be saturated when carbonatation is done at a high temperature than at a lower, and again a longer time when liming is carried out with milk-of-lime than when dry quick-lime is used. This is explained by the facts that lime to be converted into the state of carbonate must previously be in solution in the juice, that the juice dissolves more lime in the cold than when hot, and that in defecation with quick-lime more lime goes into solution than when milk-of-lime is used. If therefore a normal carbonatation be desired too high a temperature should not be used. The first carbonatation should be carried to an alkalinity of 1 grm. of lime per litre. Sometimes by accident the juices are supersaturated; the remedy for this is to add a sufficient amount of lime to raise the alkalinity to the desired degree, and to recommence carbonatation.

(Concluded.)

CONSULAR REPORTS

MEXICO.

The British Consul at Vera Cruz reports:—

Sugar.—The number of sugar plantations throughout the State of Vera Cruz is 164, but only 15 of these are equipped with modern machinery for grinding, refining, &c., 6 have a system of light plantation railway laid for the more expeditious handling of the crop. Of the 8 largest estates 3 are American, 1 French, 3 Mexican, and on 1 the lessee is a British subject.

Sugar Machinery.—The machinery, with but one exception, is of American manufacture. Formerly, machinery of British manufacture was preferred to all others, but whilst it still may lead in all other parts of Mexico, it no longer holds that position in the State of Vera

Cruz. It is possible that some of this trade might still be recovered by the personal attention of a representative of some of our better known sugar machinery manufacturers. Incidentally I may mention that I cannot remember having met or heard of a sugar machinery salesman or expert representing British firms having been in this district during the last four or five years. I do not mean to insist on this account that the field has necessarily been abandoned, as it does not follow that all commercial travellers call at the British Consulate, but I believe my conjectures to be correct, and am quite sure that business might be done, especially in connection with some of the smaller sugar houses that are not yet fully equipped with modern machinery. A list of all the sugar haciendas (plantations) in the States of Vera Cruz and Tabasco can be had on application to this Consulate.

Great progress has been shown in the sugar industry in recent years, the amount of foreign capital invested having been quite noticeable. Advanced methods of planting and harvesting are being introduced, and modern mills and refineries erected, while the old plantations are also being improved and new machinery substituted for the old installations.

For the purposes of protection, a decree went into effect on February 15, 1908, raising the duty on common and refined sugar of all kinds to 5 c. per kilo. (1¼d. per 2 lbs. 3¼ ozs.). The previous duty was just half this amount.

So fertile is the soil in the State of Vera Cruz that the average yield of cane per acre is said to be from 40 to 60 tons, replanting being necessary only about every seven years. The cane grows to a large size, and crushed at full maturity yields a density of from 9 to 11½ degrees Baumé.

The cane crop of the State of Vera Cruz for the year 1907 yielded 17,500 tons of sugar and 60,000 gallons of rum. The falling-off in exports in 1906, and more marked still in 1905, was due to the sugar crisis affecting the European and American markets, but the effect of this decline in values was modified in a degree to the Mexican planter by the increased domestic demand being sufficient to maintain lucrative prices for his product.

Formosa.

The British Consul at Tainan reports on the sugar industry of Formosa for 1907 as follows:—

It would seem that bottom prices have been reached so far as old style brown sugars are concerned. It must be borne in mind that the price of 8 yen 20 sen (17s. 1d.) per picul (133⅓ lbs.) was only payable for delivery at Tainan (Anping) and that it cost 40 sen (10d.) per picul to bring the sugar from the mills and 3 yen (6s. 3d.) per picul for consumption tax and, as the native mills charge about 2 yen 50 sen (5s. 2½d.) per picul for manufacture, the net return to the

farmer is only 2 yen 50 sen (4s. 9½d.) per picul for sugar. This picul of sugar, when manufactured by the old buffalo mill system, which gives an extraction in juice, on weight of cane, of only 45 per cent. and requires 1600 kin (19 cwts.) of cane to produce a yield of 6 per cent. of sugar, gives a net return to the farmer of only about 1 yen 40 sen (2s. 11d.) per 1000 kin (12 cwts.). An acre of land yields with the best cane about 15 to 20 tons of raw sugar (brown) so that the return per acre is about 35 to 42 yen (£3 12s. 11d. to £4 7s. 6d.).

The modern mills, employing modern machinery, secure an extraction of 70 to 75 per cent., giving a yield of 9½ to 11 per cent. of white sugar of about No. 16 Dutch standard. They pay for their cane from 2 yen 50 sen (5s. 2½d.) to 3 yen 40 sen (7s. 1d.) per 1000 kin (12 cwts.) in the field, that is to say, the mills pay for the cutting and transporting from field to mill. Generally speaking, the average price for cane paid by the modern mills is about 10s. per ton, so that the farmers do much better in a year like 1907 by supplying their cane to the modern mills. Rains having been very favourable in January, February, and March, 1908, new plantings, so far, would indicate that the 1908-09 crop will be a heavy one, probably 40 to 50 per cent. in excess of the crop for 1907-08, or 20 to 25 per cent. in excess of an average crop.

The opinions of experts on the adaptability of the wide western plains of South Formosa for the cultivation of sugar cane are highly commendatory, and it would seem that, if there were a proper system of irrigation capable of utilizing the abundant supply of land water available, this region would be an ideal one for such cultivation. There is no doubt that South Formosa has a great future in store, provided that now, with the advent of so many large modern factories, simultaneous progress is made in the more scientific cultivation of the cane by deeper ploughing of the lands with the help of steam ploughs and in the acquirement of a better knowledge of the use of artificial fertilizers for the varied soils. Of course, in speaking of South Formosa it must be understood that only the plain region extending from the mountain ranges to the east, in the centre of the island, up to the west coast is available for the purposes of sugar cultivation, as the eastern half of the island consists of a lofty impenetrable mountain region.

One circumstance greatly in favour of sugar cultivation is the fact that the rains are, as a rule, evenly distributed; they generally come at the right time and stop at the right time, which is of enormous value to Formosan sugar cultivation. Deep steam ploughing, however, is only feasible where the price of labour is high, and possibly the cheapness of labour in South Formosa and the fact that the holdings of the farmers, who lease cane lands from the landowners, or pay them in kind, are divided into such comparatively small lots, may render it extremely problematical whether deep steam-

ploughing could be universally and successfully adopted in South Formosa. The great desideratum for the country is financial assistance and cheapness of money, and this is only needed to place the sugar industry in South Formosa on an equally satisfactory footing as, for instance, in Java.

Sugar Districts.—So far as can be ascertained, practically all the available sugar cane districts of any size have been allotted under the recent laws to various sugar mills on the central factory basis. There are, however, some small districts not yet allotted incapable of supporting big mills, but there is only one large district capable of supporting a mill of a crushing capacity of 1000 tons per day, which is not yet taken up. There are, it seems, some 10,000 acres on the east coast of Formosa, which the sugar bureau would probably grant to anyone undertaking to plant cane, but as there is great difficulty in shipping on that coast, it is not probable that anyone will apply for that district.

Prospects of Sugar Industry.—The island of Formosa produced during the Chinese régime and up to the time the industry came under the control of the Japanese in 1895, 60,000 to 80,000 tons of brown sugar per annum, of which 45,000 to 50,000 tons were exported. The experience of the British firm in the district allotted to them would appear to indicate that by planting new and better cane, and by encouraging farmers to take up more land, the yield could be trebled, so that there is no reason why Formosa should not produce in the immediate future (say within the next five years) 200,000 to 240,000 tons of sugar per annum. The old style sugar was valued at 4 yen per picul, or say £7 per ton, so that the value was £420,000 to £560,000 per annum, from which the Chinese Government obtained a duty of 18 c. (4½d.) per picul, or 6s. per ton. As a result of the encouragement which the Formosan Government has given to the industry, not only will the yield be trebled, but the value has been considerably increased. Sugars, as produced by these modern factories, are worth 14 yen (£1 9s. 2d.) per picul in Japan, or 13 yen (£1 7s. 1d.) per picul in Formosa, so that the yield by the land from this industry alone will be increased eventually from between £420,000 and £560,000 to between £4,400,000 and £5,200,000, and the yield in taxes to the Government will be £1,000,000 to £1,200,000, almost enough to meet the ordinary expenditure of the island. According to the report on the trade of Japan for 1906 the consumption in Japan in 1906 was 225,000 tons, so that even if the industry is fully developed in Formosa the yield will all be taken by Japan.

There is an import duty there of 2 yen 25 sen per picul (4s. 8¼d.), or £4 per ton, on foreign sugars of No. 8 but under No. 15 Dutch standard, whilst Formosan sugars enter Japan free of duty. Besides this the Formosan Government gives encouragement in many ways, notably by supplying fertilizers, &c., therefore the sugar industry of Formosa should have a very bright prospect before it.

Sugar Factory Railways.—In all over 500 miles of 18 lbs. rails have been purchased and laid down, as well as a large number of locomotives and cane trucks by the various factories, all of which have a line to connect with the Trans-Formosan Railway, so that in the slack season these lines will probably be utilized as feeders. The gauge is generally 2 feet 6 inches, but some have the same gauge as the trunk line.

Chinde.

The sugar companies on the Zambesi suffered from want of rain in January, 1907, and later from a severe visitation of locusts. The Companhia de Assucar de Moçambique lost half its crop, and only made 1820 tons of sugar; while the Companhia de Assucar de Marromeu produced no more than 1300 tons.

The Sena Sugar Factory at Chimbue on the Zambesi, commenced operations with British capital in 1906. It is now well supplied with a large amount of valuable machinery, all of British manufacture, and its prospects are believed to be very favourable.

It is to be noted that the success of the Zambesi sugar companies is due quite as much to the assistance given by the Portuguese Government as to the suitable condition of the soil and climate for the production of sugar. The Government allows Portuguese colonial-grown sugar to enter Portugal at half duties. The ordinary import duty is 120 reis per kilo., or, say, 3d. per lb.; thus the sugar is favoured to the extent of £14 per ton over all other sugar produced elsewhere.

The amount of sugar allowed preferential duties is limited to a total of 12,000 tons a year from the East and West Coast colonies taken together. It is believed, however, that the limit will be raised before the production has reached this figure.

PUBLICATIONS RECEIVED.

The Future of Cacao Planting. By Harold Hamel Smith (Editor of *Tropical Life*). 95 pp., paper covers, 1/- net. London: *Tropical Life* Office, 83, Great Tichfield Street, Oxford Street.

This is the substance of a lecture delivered on June 11, at the Royal Horticultural Hall, on the occasion of the Colonial Fruit Show, together with a report of the discussion that followed. The book deals with the cacao-planting industry in all its branches, and includes many valuable suggestions that have not hitherto been generally discussed, much less passed into general practice. These include the use of vacuum chambers for drying the beans, the principle of planting belts of rubber and other economic plants round the cacao to distribute the financial risks, and in case of disease to resist the affected areas. Other points raised are the grafting of the trees, improved pruning methods, green manuring, &c.

OBITUARY.

CHARLES JAMES CROSFIELD, J.P.

We regret to have to record the death of one of our oldest subscribers and one of the most prominent men in the British Sugar Industry, Mr. Charles James Crosfield, who died at his residence, Anworth, Mossley Hill, Liverpool, on 17th September, 1908, in his sixty-second year. Mr. Crosfield was born in Liverpool, and after completing his education entered as a young man into the sugar refinery of Crosfield, Barrow & Co., Liverpool, in which his father, William Crosfield, was chief partner. Crosfield devoted forty years of his life to the sugar refinery business, first with the above firm, and afterwards with Crosfields Ltd. He was an experienced sugar engineer, and a sugar statistician of no mean ability; he acted as Chairman of the Lancashire Sugar Refiners' Association for many years, and was a strong and ardent fighter against the sugar bounties. He took great interest in the progress of the world's sugar industry and of inventions relating thereto. He himself took out several patents dealing with sugar refining. His name was well known not only in Great Britain but also on the Continent, in America and in the Colonies. He likewise took considerable interest in the beet sugar industry and supported his manager, Mr. Sigmund Stein, in the efforts he made to introduce this industry into England; with that object he visited beet sugar factories in France, Belgium, Holland, Germany, Austria, Hungary and Rumania. He was Chairman of the following Sugar Companies: Tongaat Sugar Company Ltd., Reynolds Brothers Ltd., and Natal Estates Ltd., all in Natal; in fact he had a good deal to do with the advancement of the Natal sugar industry. He was also a Director of the Alliance Insurance Company and of the Bold Hall Estates Company Ltd., Liverpool. He was a man of the best and highest character, true, amiable and straightforward, unable to do anything which was not in keeping with his true, gentlemanly ideas, and was beloved by everybody who came in contact with him. The very large gathering which attended his funeral gave some indication of the esteem in which he was held. He was very charitable, always ready to help anyone in need. He did much good work for the Liverpool Children's Infirmary, and was for sixteen years a Magistrate of the City of Liverpool. He married the daughter of Mr. Job, and is survived by his wife; but he had no children.

ABSTRACTS, SCIENTIFIC AND TECHNICAL.*

Blue Specked Sugar. *E. de Kruyff. Centr. Zuckerind., 1908, 16, 897-898.*

The cause of the appearance of blue specks in certain sugars has been studied by the author. For the removal of iron compounds the sugar had been treated by the "cyanide" process, in which an aqueous solution of potassium ferrocyanide is added to the concentrated juice before sulphuring and filtration.

It was at first thought the explanation was that the body formed by the combination of the potassium ferrocyanide with the iron salts in the juice became reduced by the sulphur dioxide, and this compound not being properly separated by filtration passed into the sugars and there became oxidized to Prussian blue. This theory on further consideration was thought to be incorrect because the ferrous ferrocyanide compound becomes readily oxidized by the air, whereas the blue specks appeared in the sugar after some considerable lapse of time; further, the specks appeared throughout the whole mass of sugar in the same degree on the surface as in parts where the air had only partial admission; again, the sugar was not blued regularly but in small patches scattered throughout the samples.

For these reasons the possibility of a biological action was investigated. A mixture of a concentrated solution of pure sugar with 1·5 per cent. of agar-agar was, after sterilization, inoculated with portions of the blue specked sugar. After six days' growth colonies appeared, and these appeared to consist for the greater part of fungi; yeasts and a few bacteria were also present, and careful microscopical examination showed the presence of a few mycelia and spores which were coloured light blue. In order to stimulate the growth some peptone was added to the medium, and it was then seen that some of the fungi colonies had assumed a light bluish green colour. The fungi thus isolated belonged to the *Aspergillaceae*. It was further determined that, working with *A. niger*, such fungi were not capable of growth on agar to which pure sugar was added, but that they developed when the blued sugar under examination was added. Their presence, it was therefore argued, must be due to certain impurities in the sugar.

Since potassium ferrocyanide had been used in the purification of the sugar, the next step was to experiment in this direction. A medium was prepared with the addition of about 0·1 per cent. of potassium ferrocyanide, and this was inoculated with *A. niger*. After about five days' culture greenish blue specks appeared on the plate, and these after a further few days became intensified to a dark blue colour showing in common with the blue specks of the sugar a small brownish

halo. This blue colouring matter was not affected by acids, was soluble in caustic alkalis, and showed in fact all the properties of Prussian blue.

Summing up it is stated from these experiments that a sugar will show blue specks if it contains: (*a*) potassium ferrocyanide; (*b*) spores of *Aspergillus niger*; (*c*) moisture, and impurities, particularly nitrogenous compounds and inorganic salts, which are favourable to the growth of the mould.

Utilization of Distillery Wash. *J. Effront. Moniteur Scient., 1908, 22, Pt. II., 429-434.*

The spent wash from grain, beet juice, or residual molasses distilleries contains large amounts of nitrogen in the form of amides and analogous compounds, the profitable utilization of which has hitherto not been accomplished.

The method devised by the author for this purpose depends upon the action of certain enzymes, the "amidases" in converting amide nitrogen into ammonia. These enzymes are contained in yeasts, moulds, and certain bacteria. If to an alkaline solution of asparagin yeast is added and the preparation incubated at 40° C., all the nitrogen will be converted into ammonia in three days. The filtrate from this liquid will remain strongly active towards asparagin for a considerable time. Besides ammonia certain fatty acids, particularly acetic, propionic, and butyric acids are produced. Other amido-acids such as aspartic and glutamic acids and leucine are decomposed by amidases in the same manner as asparagin.

It is stated that the application of this method to the technical scale offers no practical difficulties, and is remunerative. The slightly alkaline wash is treated with 1-2 per cent. by volume of yeast at a temperature of 40-45° C., a suitable antiseptic such as thymol being added; at the end of three to four days the greater part of the nitrogen contained in the wash can be recovered as ammonia. Instead of yeast, soil bacteria, or simply garden soil heated to 70-80° C., may be used to give the same result. Aluminium salts and aëration have an accelerating effect on this enzyme. In a trial made on the large scale 75 kilos. of ammonium sulphate and 107 kilos. of a mixture of fatty acids boiling between 100 and 145° C. were obtained from the spent wash of 1000 kilos. of molasses.

Defecation and Carbonatation by a New Method. *N. P. Ovsiannikoff. Zapiski. poswek. prom., 1908, No. 7.*, through *Bull. Assoc. Chim. Sucr. et Dist., 1908, 26, 107-109.*

The author describes his new method of "cold" defecation and carbonatation for which he has recently taken out a patent.

Lime to the extent of 2·0-2·5 per cent. on the roots worked is added to the diffusion juice at a temperature of 40-50° C.; carbonatation to

an alkalinity of 1 grm. lime per litre at the same temperature follows. The juice is next reheated, either in the carbonatation tanks or in specially constructed reheaters, until the albumenoids are coagulated, and it is then passed to the filters. By prolonging in this way the contact of the lime and juice before carbonatation the inventor claims it is possible to avoid the injurious effect a large amount of lime may have on the hot diffusion juices. This process has been employed during the 1907-1908 campaign with, it is stated, good results, the average increase in the purity obtained being given as 2·26 (87·79-90·05), as compared with 2·05 (88·25-90·30) obtained by the ordinary process of working in the previous year.

STUDIES ON DEFECATION. *J. B. Mintz. West. Sakharn. prom., 1908, Nos. 4-15;* through *Bull. Assoc. Chim. Sucr. et Dist., 1908, 26, 97-104.*

The investigations were carried out on raw juices prepared by means of a laboratory diffusion battery. It is concluded that:—

(1) The greatest increase in the coefficient of purity is obtained by working with 2–2·5 per cent. of CaO, at a temperature of 80–90° C., and with a duration of 10-15 minutes.

(2) None of the methods having as their object a reduction of the amount of lime used in defecation give results as favourable as when the normal amount is used.

(3) 1 per cent. of lime is an insufficient quantity to give the maximum defecation effect, even when very good quality roots are worked.

(4) During the reheating of juices no inversion of sugar occurs.

(5) The quantity of calcium salts remaining in solution in the carbonatated juices decreases as the amount of lime used in defecation is increased.

COLLOIDS AND SUGAR MANUFACTURE. *G. Fouquet. Bull. Assoc. Chim. Sucr. et Dist., 1908, 25, 1046-1057.*

The properties of colloids, their rôle in sugar manufacture, and the possible means of their removal are discussed.

ACCUMULATION AND TRANSPORTATION OF SUGAR DURING THE GROWTH OF THE BEET. *F. Strohmer. Öst-ung. Zeitsch. f. Zuckerind., 1908, 37, 18-21.*

During the second year when the flowers commence to appear, the amount of sucrose contained in the root decreases, being used for the building up of the portion of the plant above the earth. At this period more invert sugar than sucrose is found in the stalks and branches; the first stage of this transformation is hydrolysis into monosaccharides, this being subsequently followed by resynthesis.

Light was found to have a considerable influence on the accumulation of sugar. Plants kept in the shade for half the day during the whole period of growth yield only from a quarter to a half as much sugar as those which had been exposed to full light for the whole day under similar conditions. The roots grown in the shade were, moreover, found to accumulate larger quantities of non-sugar substances.

Other subjects are:—

RECENT PROGRESS IN SUGAR MANUFACTURE IN GERMANY AND AUSTRIA. *Em. Légier. Sucr. Indigène, 1908, 72, 3-5.*

REGENERATION OF CARBONATATION SCUMS. *H. Cayen. Sucr. Indigène, 1908, 72, 75-85.*

KOWALSKI PROCESS. *M. Kowalski. Sucr. Indigène, 1908, 72, 163-176.*

HYDROS-RAKSCHES PROCESS. *H. Emmrich. Zeitsch. Ver. Deut. Zuckerind., 1908, 707-718.*

PRODUCTION OF PAPER PULP FROM BAGASSE IN THE FRENCH COLONIES. Trade Report. *Sucr. Indigène, 1908, 72, 99-100.*

IMPROVEMENTS IN TRANSPORTATION PLANT. *H. Reichelt. Zeitsch. Ver. Deut. Zuckerind., 1908, 667-679.*

RECENT INVESTIGATIONS ON THE DISEASES OF THE SUGAR BEET. *H. Störmer. Zeitsch. Ver. Deut. Zuckerind., 1908, 718-739.*

DISEASES AND PESTS OF THE SUGAR BEET. *H. Uzel. Zeitsch. Zuckerind. Böhm., 1908, 32, 575-583.*

PEROXYDASES OF THE SUGAR BEET. *A. Ernest and H. Berger. Zeitsch. Zuckerind. Böhm., 1908, 32, 586-594.*

SULPHUROUS ACID IN ITS BIOCHEMICAL ASPECT. *L. Grünhut. Biochem. Zeitsch., 1908, 11, 89-104.*

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. THOMPSON, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; 77, Market Street, Bradford; and 322, High Holborn, London.

ENGLISH.—APPLICATIONS.

17602. J. EASTICK, London. *Improvements in the method of and apparatus for filtering sugar cane juice.* 21st August, 1908.

18237. G. W. MCMULLEN, London. *Improvements in the manufacture of sugar.* (Complete specification.) 31st August, 1908.

18407. J. VICARS, Sen., T. VICARS, and J. VICARS, Jun., Liverpool. *Improvements in sugar crushing machines.* 2nd September, 1908.

GERMAN.—ABRIDGMENTS.

198687. FRANZ HAMPL, of Elbe-Teinitz, Bohemia. *A catch jacket for separating the drain inside a centrifugal.* 17th May, 1907. This catch jacket consists of revoluble bodies, which according to their position convey the various drains into different gutters and may be

simultaneously adjusted by a device common to all and is characterized by the revoluble bodies having the form of semicircular channels fitting close together and vertically arranged round the centrifugal drum, which channels are centrically mounted and may be turned through 180°, so that they catch and carry off separately the drain according to their position by means of their semicircular internal or their arched external surface, as the case may be.

198940. PAUL ERHARDT, of Halle, a/S. *A channel and channel system for apparatus for stirring masse-cuite in mashing by means of air.* 19th May, 1907. In this apparatus the channels have an increasing section corresponding to the gradual expansion of the rising air bubbles, and a pipe or pipes lead the air bubbles to the chambers under the channels, which bubbles by means of a roof-shaped guide plate are prevented immediately escaping upwards. A further feature consists in the chambers beneath the channel or channels being partly closed at the front side by a plate and at the rear wall communicating by a slot with the chamber located above the channels.

199024. MASCHINENFABRIK GREVENBROICH, of Grevenbroich. *A wedge for inserting in sugar mould centrifugals and method of making it.* 3rd December, 1907. This invention relates to a wedge for insertion in sugar mould centrifugals, and is characterized by a pipe for closing the inner wedge chamber being tightly fitted between the bottom pieces, which pipe surrounds the apertures contained in the bottom pieces and connects the latter. The wedge is formed by the pipe being inserted in a groove provided with packing arranged on the inner sides of the bottom pieces, the bottom pieces being pressed against the ends of the pipe, and thus the bottoms firmly connected with the sides of the wedge.

199264. AUGUST GRÄNTZDÖRFFER, of Magdeburg. *A heating apparatus for vacuum pans, more particularly for the sugar industry.* 13th February, 1907. This heating apparatus consists of disc-shaped heating chambers connected with steam and condensed water pipes arranged parallelly or radially, which chambers may be composed of any suitable number and easily changed.

199397. JEAN NEUJEAN, of Aix-la-Chapelle. *An annular mould for centrifugals for making slabs rectangular on all sides from crystallizable solutions, more particularly sugar solutions.* 15th March, 1907. In this mould the spacing moulds are arranged radially and the intermediate spaces set with wedge-shaped filling pieces, so that moulding spaces are formed which are rectangular on all sides, by the polygonal form of the bottom and lid of the insertion in combination with filling wedge pieces of suitable taper and external closing plates, of such segmental section that they adapt themselves outwardly to the rounded conical form of the wedge pieces and internally form surfaces standing exactly at right angles to the sides

of the wedge pieces. A modification of the polygonal annular mould just described consists in the moulding spaces which are rectangular on all sides being divided by vertical pieces of sheet metal in the form of plates, such plates being held above and below in loose slotted plates laid against the bottom and the cover, and these latter plates being guided in grooves of the filling wedge pieces, in order to enable the mass moulded between the fixed wedges to be expelled without friction.

199429. Otto Bönke, of Klein-Ottersleben, near Magdeburg. *A gas saturator having a filtering device constructed therein, for liquids, more particularly sugar juice.* 31st October, 1906. In this saturator the filter chamber is separated from the saturation chamber by an impermeable partition having means of access adapted to be closed, with which a pipe which preferably may be branched, connects and serves alternately for introducing the saturation gas, as lift pipe for the saturated liquid and as pipe for discharging the filtered residue.

199700. Emil Passburg, of Berlin. *Process and apparatus for drying thin layers on two drums rotating in opposite directions.* 24th March, 1906. In this process the moist substances are continuously distributed in regulatable quantities in excess over two drying drums rotating in opposite directions, the excess of the material to be dried being removed from the drying drums and then again conveyed to the distributor in constant circulation. In one form of construction of the apparatus for carrying out this drying process hollow bodies provided with slots or holes are provided closely behind the scrapers in combination with a forwarding mechanism and overflow vessel for receiving the surplus material to be dried, which accumulates above the drying drums.

199753. Stolle & Kopke, of Rumburg, Bohemia. *Process for making soluble starch.* 8th July, 1906. In this process a perborate is mixed dry with the starch, whereby in the boiling, which usually takes place, a starch solution is formed, or the starch is treated with solutions of perborate at temperatures up to 40°, then filtered, washed and dried.

Note.—Copies of all published specifications with their drawings in these lists can be obtained from W. P. Thompson & Co., 6, Lord Street, Liverpool, at One Shilling a copy for English or American Patents, and Two Shillings for German. In ordering please give number and date.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of August, 1907 and 1908.

IMPORTS.

Raw Sugars.	Quantities.		Values.	
	1907. Cwts.	1908. Cwts.	1907. £	1908. £
Germany	5,226,081	4,909,870	2,469,693	2,626,380
Holland	296,485	118,671	148,620	60,687
Belgium	234,422	192,450	104,996	104,490
France	327,961	292,210	167,042	173,237
Austria-Hungary	289,442	452,406	130,618	242,427
Java	185,670	744,999	95,721	355,920
Philippine Islands	187,693	215,055	77,287	88,962
Cuba	91,113	....	39,600	....
Peru	433,438	722,358	214,364	392,757
Brazil	189,719	1,712	78,330	788
Argentine Republic	....	....	....	....
Mauritius	450,542	367,984	184,681	163,273
British East Indies	116,135	158,791	50,517	70,729
Straits Settlements	128,950	96,260	53,657	42,961
Br. W. Indies, Guiana, &c.	1,090,960	713,056	627,677	497,763
Other Countries	493,679	441,815	243,209	247,127
Total Raw Sugars	9,742,290	9,427,637	4,686,012	5,067,501
Refined Sugars.				
Germany	9,253,187	9,473,219	5,462,277	6,142,702
Holland	1,756,013	1,619,111	1,112,661	1,115,507
Belgium	226,471	113,073	137,684	74,329
France	2,487,691	1,394,411	1,451,841	927,731
Other Countries	2,635	218,712	1,830	141,431
Total Refined Sugars	13,725,997	12,818,526	8,166,293	8,401,700
Molasses	1,841,770	1,810,411	363,690	369,273
Total Imports	25,310,057	24,056,574	13,215,995	13,838,474

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	292	673	220	280
Norway	9,636	6,794	5,844	4,482
Denmark	69,080	67,287	37,439	41,195
Holland	44,837	44,404	30,109	31,716
Belgium	6,331	5,079	3,877	3,525
Portugal, Azores, &c.	13,870	13,144	7,761	8,065
Italy	16,256	5,158	8,710	3,123
Other Countries	332,124	201,436	246,774	158,461
	492,426	343,975	340,734	250,847
Foreign & Colonial Sugars				
Refined and Candy	24,511	10,971	16,150	8,601
Unrefined	58,921	334,629	35,146	210,504
Molasses	4,048	2,306	1,172	958
Total Exports	579,906	691,881	393,202	470,910

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1908. Tons.		1907. Tons.
Total Receipts Jan. 1st to Sept. 17th ..	1,525,231	..	1,536,137
Receipts of Refined ,, ,, ...	877	..	670
Deliveries ,, ,, ...	1,512,713	..	1,517,960
Importers' Stocks, Sept. 16th	18,138	..	18,177
Total Stocks, September 23rd	255,000	..	234,920
Stocks in Cuba, ,, ...	40,000	..	68,000
	1907.		1906.
Total Consumption for twelve months..	2,993,979	..	2,864,013

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1907 AND 1908.

(Tons of 2,240lbs.)	1907. Tons.		1908. Tons.
Exports	1,281,791	..	844,737
Stocks	93,941	..	65,521
	1,375,732	..	910,258
Local Consumption (8 months)	30,430	..	39,190
	1,406,162	..	949,448
Stock on 1st January (old crop)	....	..	9,318
Receipts at Ports up to August 31st	1,406,162	..	940,130

Havana, August 31st, 1908. J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR EIGHT MONTHS, ENDING AUGUST 31ST, 1908.

SUGAR.	Imports. 1906. Tons.	1907. Tons.	1908. Tons.	Exports (Foreign). 1906. Tons.	1907. Tons.	1908. Tons.
Refined	621,969	686,300	640,926	1,415	1,226	549
Raw	541,429	487,114	471,382	7,432	2,946	16,731
Molasses	90,129	92,088	90,521	274	202	115
Total..........	1,253,527	1,265,502	1,202,829	9,121	4,374	17,395

	Home Consumption. 1906. Tons.	1907. Tons.	1908. Tons.
Refined..	598,121	663,748	626,114
Refined (in Bond) in the United Kingdom	371,484	335,454	347,293
Raw	82,756	82,147	78,678
Molasses	84,783	87,596	86,687
Molasses, manufactured (in Bond) in U.K.	39,213	41,523	43,434
Total	1,176,357	1,210,468	1,182,206
Less Exports of British Refined......................	31,478	24,621	17,199
Total Home Consumption of Sugar	1,144,879	1,185,847	1,165,007

STOCKS OF SUGAR IN EUROPE AT UNEVEN DATES, SEPT. 1ST TO 19TH. COMPARED WITH PREVIOUS YEARS.

IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	TOTAL 1908.
142	191	205	166	36	740

	1907.	1906.	1905.	1904.
Totals	898 ..	1088 ..	773 ..	1103

TWELVE MONTHS' CONSUMPTION OF SUGAR IN EUROPE FOR THREE YEARS, ENDING AUGUST 31ST, IN THOUSANDS OF TONS.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria-Hungary	Holland, Belgium, &c.	Total 1907-08.	Total 1906-07.	Total 1905-06.
1832	1208	660	548	208	4455	4396	4440

ESTIMATED CROP OF BEETROOT SUGAR ON THE CONTINENT OF EUROPE FOR THE CURRENT CAMPAIGN, COMPARED WITH THE ACTUAL CROP OF THE THREE PREVIOUS CAMPAIGNS.

(From Licht's Monthly Circular.)

	1907-1908.	1906-1907.	1905-1906.	1904-1905.
	Tons.	Tons.	Tons.	Tons.
Germany	2,127,000 ..	2,239,179 ..	2,418,156 ..	1,598,164
Austria	1,425,000 ..	1,343,940 ..	1,509,789 ..	889,431
France	728,000 ..	756,094 ..	1,089,684 ..	622,422
Russia	1,410,000 ..	1,440,130 ..	968,500 ..	953,626
Belgium	232,000 ..	282,804 ..	328,770 ..	176,466
Holland	175,000 ..	181,417 ..	207,189 ..	136,551
Other Countries .	435,000 ..	467,244 ..	410,255 ..	332,098
	6,532,000	6,710,808	6,932,343	4,708,758

THE

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☞ All communications to be addressed to the Editor, Office of "The Sugar Cane," Altrincham, near Manchester.

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The Editor will be glad to consider any MSS. sent to him for insertion in this Journal and will endeavour to return the same if unsuitable; but he cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTICE TO READERS.—If the Advertisement pages stick together, bang their edges on the table, when they should easily separate.

NOTES AND COMMENTS.

A Solar Motor.

The *Agricultural Journal of India* refers to a novel machine known by the name of Solar Motor and worked by the heat of the sun's rays for raising water for irrigation, which is claiming considerable attention in the United States. The idea is really an old one; but it does not appear to have been adopted on any large scale till just lately. The apparatus consists of a steam engine and boiler, the heating medium of the latter being the concentrated rays of the sun acting through a reflector. This reflector is in the form of a truncated cone, 35 feet in diameter across the top and 17 feet at the bottom. It intercepts about 1000 square feet of sunshine and reflects it on the boiler, which is a copper tube, about 9 feet long and 12 inches in diameter. It is rigidly fixed in the centre of the reflector and revolves with it. The reflector swings round and follows the sun, as the result of a simple clockwork device. The boiler supplies steam at a pressure of 150 lbs. per square inch to a steam pump. Both reflector and boiler are mounted on supports.

It is said that the whole plant works almost automatically. All that is required is to focus the reflector in the morning and start the clockwork. It takes about one hour to raise steam, and the power for work depends upon the time the sun is above the horizon and free

from clouds. A Solar Motor of 10 h.p. can lift about 1400 gallons of water per minute from a depth of 12 feet. It costs, in America, about £400. In that country these Solar Motors are chiefly used to work pumps for irrigating the dry lands in California, where one motor suffices to irrigate from 150 to 400 acres of land, according to the nature of the crops. The farmers pay from £2 to £3 per acre for such irrigation.

It may be added that another Solar Motor, based on the action of the unconcentrated rays of the sun, has recently been invented in America. By storing power in hot water, this motor has been worked night and day. The whole plant is entirely automatic. The total cost is stated to be as follows:—

	£
Cost of a Sun-Heat Absorber	30
,, ,, Storage Tank for Hot Water	5
,, ,, Turbine Condenser and Pumps required for handling the Condensed Water	50
	£85

For those sugar districts where an uninterrupted supply of tropical sunshine can be depended on, a Solar Motor should prove a profitable investment where pumping or electric generation is regularly needed.

Cane Farming in Trinidad.

According to Professor Carmody, cane farming by peasants is on the increase in Trinidad, and some data thereon which he has lately collected are of much interest. On the St. Augustine, a Governmental estate, there are 328 farmers, of whom the majority tend from 5 to 15 acres of canes. The highest yield per acre reaped was 29½ tons, while the average worked out at 11 tons 14 cwts. The average yield of 17 farmers who produced over 20 tons was 24½ tons per acre. These figures show an improvement over those for 1905, when the average yield obtained by 399 farmers holding 1753 acres was 5 tons. But even this average of 11¾ tons per acre is shown by the maximum yields to be far below what might reasonably be expected of the cane farmers. To the estate owners Professor Carmody recommends the advantages of the share system of cane cultivation as practised in Fiji, Hawaii, and Mauritius. Trinidad's system of cultivation is its weak spot; more mechanical tillage is required to loosen the soil to a greater depth, and for this purpose suitable implements held on the share system are needed, for the individual farmer has no capital to supply his own wants in that direction. Apart from that, the estate owners require to exercise more supervision and themselves supply disinfected planting material and suitable manures. The cane farmers cannot or will not themselves treat their cane tops before planting so as to avoid fungoid disease; and the only manure they

have is pen manure, and very little of that. Any money to purchase artificial manures must be found by the estates. A useful incentive to obtaining good yields is to offer prizes at agricultural shows for the best farmers' canes grown in the district. This plan has already been tried with success and the results are stated to have been most beneficial.

It may be worth while giving the figures of cane and sugar production of Trinidad during the last three years. They are as follows:—

Year.	Total sugar production. Tons.	Estate-grown canes. Tons.	Farmers' canes. Tons.	Price paid. $	Cane Farmers Number & Nationality. West Indian	East Indian.
1905	38,240	244,418	144,868	482,053	5,462	5,424
1906	62,975	397,912	237,844	469,122	5,446	6,127
1907	50,564	395,863	166,993	340,527	5,777	6,557

Imports of Sugar into China.

The import of foreign sugar into Tientsin amounted to 6,575,742 piculs in the year 1906, against only 2,564,787 in the year 1901, according to the German Consul's report for the year 1907. Notwithstanding this considerable increase, the amount of sugar grown in China remained stationary, so that the larger imports consisted of foreign sugar only. The production of sugar in China seems to decrease every year, for the reason that the Chinamen make no attempt to improve on their obsolete methods of working, and, therefore, cannot compete against their better equipped neighbours. The bulk of the sugar imported into Tientsin consisted of so-called molasses sugar from Java, which is sent to Hong Kong and, after being packed there in smaller packages, is forwarded to Chinese ports. Next comes the white sugar, made direct from cane juice without undergoing any refining. Formerly this came almost exclusively from Hong Kong, but since the Japanese sugar industrials have turned their attention to cane cultivation and sugar manufacture in Formosa, the competition of Formosan sugar has begun to make itself felt distinctly. Besides that Java has improved her methods and produces a very high-grade white, though unrefined, sugar. The third kind of sugar is refined, either from Hong Kong or from the Japan refineries or else from Europe. The Hong Kong and Japan refineries, however, keep the prices always a little below the European quotations, so that it is very difficult for European refined sugar to hold its place in China, and it will not be long before the whole of the import into China and Japan will consist of cane sugar only.

The Japanese are doing great things in Formosa, and intend accomplishing still greater ones; in fact, they want to raise all the sugar which is needed for their own consumption, and which they now at least refine in their own territory, and there is every probability of their succeeding in the long run.

Labour for Surinam.

The cane sugar industry of Surinam is much hampered through lack of labour. The planters import coolies from British India every year, but not to the full extent needed. For this reason, therefore, and for political ones, too, repeated efforts are being made to obtain workmen from Java, as these are likewise Dutch subjects, and, therefore, do not require the supervision of the agent of a foreign government, as is the case with the British Indian immigrants. Now, as a rule, the Javanese do not want to leave their island, and when they do they are sure to get work enough on the tobacco estates of Sumatra, a few days' travel from their own place. It is, therefore, evident that the Surinam planters will not get the pick of the people, and complaints are heard on one side of unsatisfactory work done, and on the other of unsatisfactory pay given for such work.

As the Surinam Government planned the allotment of land to their cane planters in such a way that private people might be induced to build a central factory for working a district, and on the other hand the Association of Sugar Manufacturers who will undertake this will not start work until the labour question is solved in some way or other, the Dutch Government has sent over a high Java official to Surinam, with a view to studying the question and suggesting measures by which an immigration of able-bodied Javanese field labourers can be arranged for, both to their own benefit and of course to that of Surinam too.

STOCKS OF SUGAR ON SEPTEMBER 1st, 1908.

The following, according to Otto Licht, were the visible supplies of sugar on September 1st for the last three years:—

	1908.	1907.	1906.
Germany	181,748	188,667	209,749
Hamburg	46,220	55,670	67,540
Austria	147,510	163,492	168,554
France	225,448	358,334	472,795
Belgium	29,747	40,905	56,766
Holland	6,665	10,992	19,499
England	150,541	154,300	169,819
United States	237,995	280,721	255,875
Cuba	67,000	93,491	69,836
Under sail	320,000	191,200	112,180
Tons	1,412,874	1,537,772	1,602,613

The year 1908 thus shows a decrease of 124,898 tons as compared with 1907.

M. YVES GUYOT AND THE NEW SUGAR CONVENTION.

The great exponent of free trade doctrines in France, Yves Guyot, has at various times and in diverse circumstances spoken out boldly in opposition to the sugar bounties and in favour of free trade rightly so called. His help came at an opportune moment and did much to keep the ball rolling in the right direction. It is no use to regret that that help did not come thirty years earlier, when the ball first began to roll and only required a good push from the other side of the channel to bring it to a successful goal. It was the sham free-traders who stopped the rush and threw us back again and again. If he had shown up their fallacies at that time the bounties might have been abolished in 1877 or 1888. But it was not to be. It took thirty years to overcome a blind, erroneous and mischievous opposition, based on a false dogma, supported by the energy of fanaticism, and still more, we fear, by gross party spirit and petty personal jealousies.

The growth of the sugar bounties was a slow and interesting process. They started in a very hidden and mysterious way. Apparently accidental but really well known to those who enjoyed them, and soon discovered by those who suffered from them, they rapidly spread from France, Holland, and Belgium to Germany and Austria, and there attained to the rank of a scientific and openly avowed system of encouragement to a growing and beneficent agricultural and manufacturing industry of first-class importance. Then set in the bitter fight of competing bounties, each country trying to outbid the others and get the export trade. The original hidden bounty to the Paris refiners, which attained to monster dimensions after the war of 1870, almost disappeared ten years later, condemned owing to the fierce light thrown upon it during the agitation carried on with great vigour during that decade, and especially by the international conferences of 1875-6-7. The French beetroot sugar manufacturers, during that time, saw with envious eyes these great bounties flowing into the pockets of half-a-dozen millionaire sugar refiners, while their own great national agricultural industry had to struggle on without any State aid. But when Germany and Austria showed how the industry could be helped and stimulated by a well-devised system of bounties the French Government wisely followed their example. We say wisely, but the wisdom did not last long. The French was an absurdly exaggerated imitation of the German and Austrian systems and soon became an overgrown and top-heavy arrangement which was bound, sooner or later, to break down of its own weight. But while it lasted it showed wonderfully successful results. The French crop increased by leaps and bounds. The acreage more than doubled and so did the yield of sugar from the roots. The French industry

was not only saved from destruction but was placed on a pinnacle of great temporary prosperity.

And while all this was going on the sugar producers and manufacturers of the rest of the world were being so severely handicapped that it was only a question of time, when they would inevitably be driven out of the competition. They naturally complained that free trade, so far as sugar was concerned, had been destroyed. Sugar receiving a bounty was in exactly the same position in British markets as if it enjoyed preferential treatment. Many honest free traders saw the point at once and backed up the cry for a remedy—the only remedy—a duty to countervail the bounty, a policy which one free trader declared to be not only consistent with free trade but positively conceived in the interests of free trade. A Committee of the House of Commons, after two years of careful and exhaustive investigation of all the facts and arguments, came to the same conclusion.

But the fanatics, who never ceased to shout the sacred words "duty for revenue purposes only," would listen to nothing, and raved at even a whisper of the words "countervailing duty." As is often the case in the history of the world, the fanatics prevailed.

In the meantime a new feature had appeared in the region of the bounties. During the earlier international Conferences the Dutch Delegates had occasionally pointed out that one fruitful source of bounties might be found in the excessive surtaxes which existed in some countries. At last Austria and Germany gave practical illustrations of this fact. The industries of producing and refining sugar in Austria formed themselves into a Cartel, binding themselves not to sell for home consumption below a certain fixed price. The same industries in Germany soon followed the example. The effect was instantaneous. The price for home consumption went up several shillings per cwt. and the extra profit went into the pockets of the sugar producer and the sugar refiner.

This at once threw all other bounties into the shade, and ruin was seen to be imminent,—ruin not only to those who received no bounty, but even to those who in other bounty-giving States had not sufficient bounty to enable them to compete. Thus the whole bounty system of Europe was brought to a deadlock.

It was at this juncture that M. Yves Guyot took up his parable, and very well he spoke out. The French system had become so overgrown that it was breaking down of its own weight, and the time was ripe for M. Yves Guyot to expose its absurdities. He published a scathing denunciation of the whole affair; he wrote letters to *The Times* advocating the imposition of a countervailing duty on bounty-fed sugar; and, finally, he read a paper before our Royal Statistical Society. By that time the Conferences at Brussels in 1901-2 had done their work, and the Convention had been signed but not ratified. He

wound up his paper with the following memorable observations, full of value at the present critical moment:—

> "M. de Smet de Naeyer, the Belgian Minister of Finance, who occupied the position of President of the Sugar Conference, stated clearly enough the importance of the work which the Conference had done; nor did he exaggerate when he said that 'the Convention is a work of international solidarity based on the most rational principles of economic science.' He was also correct in describing it as a work of peace; for by denouncing the system of bounties the Delegates condemn Protection in its least justifiable form, that of aggression. The success of the Sugar Conference is the most important achievement of economic liberal policy in Europe since the signing of the Commercial Treaties of 1860."

These wise words had no effect on the fanatics, who howled louder than ever when the time drew near for the ratification of the Convention. No depth of misrepresentation was too low for them. They declared that there would be a rise of 5s. per cwt. in the permanent price of sugar, that the consumer would be reduced almost to starvation, and that Continental producers would have a monopoly of the market. The exact opposite was manifest, but their loud and persistent cries misled the public, who could not understand that the Convention had saved the consumer from the threatened monopoly of the market by the bounty-fed producer, by abolishing the bounties and restoring free competition; that it had saved him from the periodical glut of sugar, which forced prices down for a time to a point at which competition was impossible—an artificial glut which was always inevitably followed by reduced production and high prices; and, thirdly, that it would eventually save him from being dependent on a small portion of Europe for the greater part of his sugar supply, and of being, therefore, subject to a great rise in price whenever there was a deficient beetroot crop.

All these facts the fanatics carefully concealed, but the Convention was ratified and came into operation at the appointed time. The fanatics continued to rave, and had a rare bit of good fortune in 1904-5, when drought on the Continent suddenly knocked 1,200,000 tons of sugar off the beetroot crop. "We told you that the Convention would raise the price of sugar!" cried the fanatics. They carefully concealed the facts of the drought, and of the consumer being dependent on the beetroot crop for his supply of sugar—a dependence created, of course, by the bounties, which had artificially stimulated the beetroot industry and simultaneously discouraged all other sugar production.

The change of Government in 1906 gave the fanatics another chance and obliged Sir Edward Grey to announce to the Parties to the Convention that, while we should be very glad if they would kindly continue the abolition of their bounties, we should have to ask them, so

far as our own markets were concerned, kindly to permit their sugar producers to compete with bounty-fed sugar from Russia in those markets. This is the Government's idea of free trade. The foreign Governments, far from indignantly repudiating such a preposterous proposal, meekly accepted it, and even went further and actually admitted Russia to be a Party to the new Convention—Russia and her bounties. It is incredible, but it does great credit to our Delegate, Sir Henry Bergne. As the *Journal des Fabricants de Sucre* bitterly remarks:—

"So it always is, that the Continental Powers feel obliged to bow to the exorbitant pretensions of the latter [England]."

In the same article (16th September) the *Journal* gives us M. Yves Guyot's pertinent criticism of this comical situation.

"These English," writes M. Yves Guyot, "declare themselves to be free-traders: but they commit Protectionism, they demand the right to benefit by the bounties which M. de Smet de Naeyer declared, with good reason, to be aggressive protection.

"The English would like to enjoy an arrangement which may be described in these words: the Continent for the industry, the English have the sugar.

"That is to say:—On the Continent, the French, the Germans, the Austrians, the Belgians, the Dutch, take the trouble to cultivate the beetroot, to engage capital in sugar factories, to hire workmen for the manufacture; and, when they have given themselves all this trouble, their countrymen pay the English to eat the sugar they have produced.

"That the confectioners, the makers of preserves, the makers of biscuits find this arrangement convenient to them I can understand; but what I have never been able to comprehend is that the *free-traders* can admit the right, on the part of a Government of another country, to create in their country an artificial competition.

"It is true that they reply to you in a most matter of fact way: These export bounties have no doubt hurt our refineries, driven away the sugar of our Colonies; but they have been of advantage to our confectioners, our makers of preserves, our makers of biscuits; they have given to them a monopoly of this kind of manufacture.

"They raise their cries so high that the present ministry has not dared to maintain the penal clause.

"And yet it is the mainstay of the Convention of Brussels.

"The British Liberal Government has declared that it cannot continue to apply the penal clause, and has threatened to retire from the Brussels Convention.

"We have therefore arrived at this absurd result, that the English Government continues to be a party to the Convention, but has the right no longer to apply the penal clause.

"If the British Government had completely retired from the Convention it would have continued to exist. The experience of the bounty system has been too onerous to admit of any return to it, and all the sugar manufacturers who take the trouble to study the facts, instead of repeating the formulas of political men who flatter them, or obeying their passions, know well from what a cataclysm the Brussels Convention has saved the whole sugar industry of the Continent."

The *Journal* adds:

"M. Yves Guyot is undoubtedly not far from thinking with us that a double fault has been committed in stripping the Convention of its natural character; namely, by tolerating that England should be freed from the undertaking to apply the penal clause; and by admitting Russia, with her bounties, to the Convention."

THE DETERMINATION OF REDUCING SUGARS FROM THE WEIGHT OF CUPROUS OXIDE.

By C. A. Browne,

(Chemist-in-Charge, New York Sugar Trade Laboratory).

From the recent articles by Zerban and Naquin and by Walker in the *International Sugar Journal* it would seem that the use of the Neubauer crucible depends entirely upon whether the copper is to be weighed as Cu_2O or as CuO. The increase in weight noted by Zerban and Naquin in weighing the copper as Cu_2O may perhaps be due to a slight oxidation of the Cu_2O when in contact with the spongy platinum. This phase of the discussion, however, is a minor one in comparison with the main point, which is, that in the determination of reducing sugars in commercial products the copper should never be weighed as Cu_2O when accuracy is desired. Weighing as Cu_2O may give correct results in the case of pure sugars and products of high saccharine purity, but the danger of contamination with organic and mineral matter is too great when other materials than those of a carbohydrate nature are present. This fact, which was emphasized by the writer in his reports as Referee upon Sugar for the Association of Official Chemists in 1906 and 1907, and again referred to by Zerban and Naquin in their recent paper, seems to have been entirely overlooked by Mr. Walker in his reply to Zerban and Naquin's article.

To show the extent of the error which may result from determining the copper as Cu_2O in certain products the writer quotes the following figures by Sherwood and Wiley from his report in the Proceedings of the Association of Official Chemists, 1906, page 120:—

Material.	Reduced Copper. From weight of cuprous oxide. Gram.		From weight of cupric oxide. Gram.		Volumetric method (Low) Gram.
Molasses residuum	0·3753	..	0·3594	..	0·3494
Ditto	·3905	..	·3634	..	·3470
Ditto..	·2517	..	·2348	..	·2242
Ditto	·3287	..	·3130	..	·3034
Ditto..	·3291	..	·3134	..	·3029
Ditto	·2768	..	·2698	..	·2688
Ditto..	·2709	..	·2620	..	·2612
Pure dextrose	·4619	..	——	..	·4617
Ditto..	·2449	..	——	..	·2444
Ditto	·1251	..	——	..	·1257
Beer	·0755	..	——	..	·0753
Ditto	·0746	..	——	..	·0748
Molasses	·4628	..	——	..	·4520
Corn juice	·3360	..	——	..	·3134
Malt extract	·3322	..	——	..	·3048
Ditto	·3160	..	——	..	·2933
Ditto..	·2093	..	——	..	·193[illegible]

In the results obtained upon the molasses residuum the precipitated cuprous oxide after weighing was ignited in a muffle furnace and weighed as cuprous oxide according to the method of the French chemists; the cupric oxide was then dissolved in nitric acid and the copper estimated by the volumetric method of Low. The results show a contamination of the cuprous oxide with organic matter as shown by the differences in copper as calculated from the suboxide and oxide, and with mineral matter as shown by the differences in copper as calculated from the oxide and by the volumetric method.

With solutions of pure sugar and such liquids as beer, where the organic matter consisted largely of carbohydrates, the calculation of copper from the weight of cuprous oxide gave accurate results. In the case of the malt extracts, which contained added peptones, the precipitated cuprous oxide seemed to act somewhat as the copper hydrate of Stutzer's reagent and to carry down a considerable amount of albumnoid matter from solution, in the case of the molasses the precipitated copper seemed to be in partial combination with certain nitrogenous bases such as xanthin.

Further studies of methods for copper determination were made the succeeding year by a number of chemists upon various sugar-house products, using different methods of clarification. The results of this work, quoted from the writer's report, as Referee upon Sugar from the Proceedings of the Association of Official Chemists for 1907, are, in part, as follows:—

Reducing Sugars as Dextrose in Raw Sugars.

Clarifying Agent and Analyst.	Allihn Method.			Munson & Walker Method.		
	Weighing as Cu_2O.	Weighing as CuO.	Titration of Cu by Low's Method.	Weighing as Cu_2O.	Weighing as CuO.	Titration of Cu by Low's Method.
No Clarifying Agent—	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
A. H. Bryan..	6·45	6·22	5·88	6·29	5·98	5·83
W. D. Horne	7·08	7·05	7·02	6·43	6·51	6·37
Average	6·77	6·63	6·45	6·36	6·25	6·10
Lead Subacetate Solution—						
A. H. Bryan..	6·14	5·67	5·67	5·76	5·51	5·30
W. D. Horne	6·61	6·51	6·51	6·19	6·01	5·99
Average	6·38	6·09	6·09	5·98	5·76	5·65
Lead Subacetate Dry—						
A. H. Bryan..	6·05	6·00	6·02	5·75	5·72	5·62

Reducing Sugars as Dextrose in Molasses.

Clarifying Agent and Analyst.	Allihn Method.			Munson & Walker Method.		
	Weighing as Cu_2O.	Weighing as CuO.	Titration of Cu by Low's Method.	Weighing as Cu_2O.	Weighing as CuO.	Titration of Cu by Low's Method.
No Clarifying Agent—	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
A. H. Bryan..	19·77	19·37	19·45	19·20	18·34	18·43
W. D. Horne	20·60	20·06	19·97	20·00	19·43	19·44
Average	20·19	19·72	19·71	19·60	18·89	18·94
Lead Subacetate Solution—						
A. H. Bryan..	17·51	16·47	16·29	17·27	16·26	15·97
W. D. Horne	19·45	19·16	19·16	19·00	18·53	18·26
Average	18·48	17·82	17·73	18·14	17·39	17·12
Lead Subacetate Dry—						
A. H. Bryan..	17·85	17·55	17·57	17·60	17·32	17·27

The results of the experiments quoted show that it is more accurate to weigh the copper as CuO than as Cu_2O. In the case of the results upon the raw sugar the weighing as Cu_2O gives an average of 0·24% higher, and the weighing of CuO an average of only 0·09% higher than by direct determination of copper. In the case of the molasses the weighing as Cu_2O gives an average of 0·54% higher and the weighing as CuO an average of only 0·05% higher than by direct determination of copper. Mr. Walker gives as the disadvantage of weighing as CuO that it is not so convenient to refer to the copper values of the Munson & Walker tables as to refer to the Cu_2O values. It is not, however, a question of what is most convenient, but a question of what is most accurate. It is unfortunate that Messrs. Munson & Walker should have incorporated the weighing of copper as Cu_2O as an integral part of their otherwise most excellent tables, and the writer again takes occasion to call the attention of chemists to the serious errors attending this method of of procedure in the analysis of commercial products.

SUGAR CANE BORERS IN BEHAR.

In a recent number of the *Agricultural Journal of India*, Messrs. M. Mackenzie and H. Maxwell-Lefroy contributed a detailed study of the Sugar Cane Borers of Behar, India, accompanied by coloured illustrations of the pests. While, in the absence of such illustrations it is not an easy matter to identify specimens from a written description, yet it may be of some aid to future research if a résumé of this paper is given in the pages of this Journal. Our readers will, therefore, find below some description of the pests referred to.

The investigations which formed the basis of the article comprised certain observations of cane Moth Borers, and were carried out mainly in one district (Sarum). The term "Moth Borer" is used to denote a caterpillar which bores into the tissues of the cane plant, and eventually becomes a moth. Three different types were noted: (1) Shoot Borers, which enter the cane by tunnelling downwards through the shoot or terminal bud; (2) Side Borers, which enter the cane at the side; and (3) Root Borers, which bore into the roots of the cane.

Under the classification of Shoot Borers are two moths, the White Moth (*Scirpophaga auriflua*) and the Black Spotted Moth (*S. monostigma*). Both are essentially white moths, but the second has a small black speck on each forewing. The hind end of the body is formed by a tuft of hair, which is large in the female, and is either buff-coloured or the outer hairs are red, the inner ones buff. The White Moth does much more damage than the Black Spotted. In some seasons, favourable to the development of this insect, it is

probable that at least 80 per cent. of the Behar cane crop is affected by it. And in that case the cane ceases to grow. When either of these pests attacks a field badly, the cane has a general appearance of drying up, owing to the top shoots, which are the portions attacked by the insect, having quite withered, forming what are known as "dead hearts." If a "dead heart," or withered shoot, is pulled out by the hand, it is found quite rotted, and has a most offensive smell. If looked at carefully, most probably a number of very small maggots, the larvæ of a very small fly, may be seen in the rotted portion. These are not the cause of the withering and subsequent damage to the cane. That is to be found lower down, where the depredations of the Borer caterpillar take place.

The eggs of these moths are very similar in size, shape, and appearance; they are elongate, oval, and usually laid in clusters of from 60 to 80, most often on the underside of the fourth leaf from the top, though any leaf may serve. Covered with buff hairs from the oval tuft of the female moth, the eggs form a compact cluster $\frac{1}{4}$ in. long by $\frac{1}{8}$ in. in breadth, and are not at all difficult to detect by one who knows where to look for them. The eggs usually take from 11 to 12 days to hatch out; the caterpillars, on emerging, are about $\frac{1}{12}$ of an inch in length, very active insects, with head and thorax shining black; a narrow, whitish band between thorax and body above; body reddish brown, studded with erect spines or hairs longer than the thickness of the body. On the second day they apparently shed their skins, the head and thorax become reddish-brown, the thorax and body a very pale green, with dark dorsal line; the hairs on the body are few and short, and the length of the larvæ about $\frac{1}{8}$ of an inch. These observations, it should be added, were made from insects hatched in captivity. The young larvæ lose very little time after hatching in boring into the unfurled leaves on terminal shoots of the cane stem; they eat their way through the shoot, riddling the latter with small holes. After penetrating the leaf they burrow down until they reach the sappy portion of the cane stem, from which point the real work of destruction commences. The boring insect eats its way downwards through at least three or four joints from the top; or should the joints or nodes be very close together, as often happens, six or even seven internodes may be tunnelled. During this process of boring, a period of 22 days has elapsed and the larva has meanwhile acquired a length of about three-quarters of an inch. It is now a dull creamy white, the intersegments and dorsal streak darker, with a few scattered hairs all over the body, while the head is pale yellow. At this juncture the chrysalid stage is reached, and the insect bores out a chamber and lines it with silk; and it then closes up the opening, and retreats to the further end of the chamber, spinning a series of silk partitions, which thoroughly safeguard it against outside danger.

The effect of operations of this borer on young canes is most disastrous. The shoot which has been attacked usually dies, as it is too young to withstand the shock. In old canes, on the other hand, the cane does not die, but all further growth of the sugar-producing stem is entirely stopped, and the top six inches is entirely unfit for crushing. The eyes or buds of this cane throw out long shoots at the expense of its sugar-producing value.

The chrysalis, under ordinary circumstances, remains in its chamber for ten to twelve days. The pupa of the male is much smaller than that of the female, the former measuring about half-an-inch, the latter about three-quarters of an inch. At the end of the time mentioned the moth issues forth. The emergence usually takes place about an hour after sunset. Mating takes place the first night, and the eggs are laid on the second night.

Thus, the entire period occupied for one generation from egg to moth is only about 45 to 50 days, so that in an average season in Behar there are from five to six generations of the moth during the year.

SIDE BORERS.

Four different species of Side Borers have been recorded, viz., the common Moth Borer (*Chilo simplex*), the Gold Fringed Moth Borer (*Chilo auricilia*), the Pink Borer (*Nonagria uniformis*), and the Green Borer (*Anerastia ablutella*). The first and fourth are the most common in Behar.

THE MOTH BORER (*Chilo simplex*).—The eggs are deposited freely on cane leaves. The young caterpillar may enter the young cane shoots when from 18 inches to two feet high, either just above ground level or at any point higher up to within say a foot of the top of the shoot. In the former case it will tunnel its way upwards until it has consumed all the sappy portions of the stem, when it will leave that and enter into an adjacent one. In the second case it will bore down until it reaches the root stock, and will pass from shoot to shoot until the period for its pupation arrives, when it bores a hole laterally and seals itself in with a web of silk. The exit of this hole is always above ground. The *C. auricilia*, unlike the other borers, allows others of its own species to occupy the same burrow. These details concern canes in their early stage of growth before defined nodes appear. In the later stages the boring results as a " dead heart," as in the case of *Scirpophaga auriflua*, and on plucking out the dried tip one can always tell by a casual examination of it which of the two borers has been at work. In the case of *Chilo*, no punctures showing the entry of the insect will be found; whereas, in the case of the *Scirpophaga*, as a rule, numerous small holes will be found, showing where the young larva has penetrated into the growing tip prior to tunnelling its way down to the stem. Later on, when the nodes have

appeared in the cane, the attacks of *Chilo* show no signs of a "dade heart."

The chrysalis stage lasts from ten to twelve days in cool weather, though only six to seven in hot weather. The moth is wholly nocturnal, and does not rest openly on plants in the open, as does the White Moth. It is, therefore, practically never seen, and will only be found if a light is placed in the field.

THE PINK BORER (*Nonagria uniformis*).—This is the largest of all the cane borers referred to in this paper, and its caterpillar commits considerable damage. The latter is most easily recognised by its colour: it is smooth in body, with few short hairs, a brown head, and a distinctly pink tinge all over the body. It grows to a length of 1½ inches, and has no brown spots on it, as has the caterpillar of *Chilo simplex*. The chrysalis stage covers a period of nine to ten days. Though found in cane, this borer is far more frequent in other crops, and would be found abundantly in cane probably only when the other crops were not available.

THE GREEN BORER (*Anerastia ablutella*) is found in great numbers when the young cane is about three weeks to a month above ground. The young caterpillar enters the shoot just below the surface of the ground, and first of all eats its way up the stem for about three inches, then tunnels down till it reaches the juncture of the stem with the planted cane; or should by this time the attacked stem be showing signs of joints, the larva will stop short at the first joint and, as a rule, never penetrate further. It then leaves that shoot and enters an adjacent one, and goes on feeding for, probably, a period of three weeks. It is pretty safe to reckon 21 days for the larva stage, and eight to nine days for the pupa. This borer leaves the cane and pupates in the ground. It is bright green in colour, and cannot be mistaken for any of the other known cane borers; it measures three-quarters of an inch.

ROOT BORERS (*Polyocha saccharella*).

Perhaps the most deadly of all the cane borers is the one that attacks the roots. Most fortunately they do not appear to be as numerous as the other borers, but they are, nevertheless, responsible for a great amount of damage attributed to white ants and other causes. The body of the caterpillar is white, with darker intersegmental rings; the head light brown; length from ¾ to 1 inch. It attacks the cane from about the time when the latter is from three weeks to a month old. It commences its life by boring into the cane stem low down, from which point it passes into the roots, where it spends the remainder of its existence. As many as eight of these borers have been taken from the roots of one root stock. The result of the attack of this pest is that in a great many cases the whole stool dries up, or, at any rate, has a stunted or shrivelled-up appearance.

It is not yet known to attack anything but cane: and cane-planters would do well to pay attention to it if they find shoots dying off, not as "dead hearts" but wholly and from some point below the soil. There is one important point in the treatment of this borer, and that is to take up the stools of cane as soon as possible after the canes are cut, and either put them in a real compost heap under several inches of earth or burn them outright.

The moths of the seven insects referred to above are all extremely similar; five of them are the colour of a dry grass stem or withered cane leaf. For the planter it is important to be able to identify the caterpillars.

Remedies.—The best method of treating a cane crop as regards Moth Borers may be summarized as follows: At planting time, the plant cane should be cut into setts, these latter rejected if bored, and if sound dipped into either Bordeaux mixture or a cold solution of copper sulphate (blue stone) in water. This checks white ants. The young canes should be periodically gone over, all "dead hearts" cut out, all egg masses collected; the former should be destroyed by burning, by being chaffed and fed to cattle, or by burying in a compost heap; the latter are taken from the cane field and simply exposed where the parasitic flies can escape, *e.g.*, put in a tray or dish standing in a larger dish of water or in a tray with a water gutter round the rim. The parasites hatch out and fly away; the caterpillars that hatch die being unable to cross the water. If possible, an early crop of maize should be grown to attract the Common Moth Borer (*Chilo*), and if this is full of the caterpillars, it should be fed to cattle or treated in some manner that will destroy the insects. When the cane is being cut, all "bushy tops" should be dealt with as containing White Moth Borers; the rejected bored canes which are usually left on the field as worthless should be collected and properly destroyed, and as soon as possible after cutting all stumps should be taken out and so dealt with that the Root Borer will not be able to complete its life. At the same time it is worth while making certain that the stacked fodder is not a source of danger by breeding Moth Borers (*Chilo*), and that the stacks are properly covered in so as to prevent the escape of the insects.

These are the only practical precautions that can be taken against borers, but if they are properly carried out, the great loss sustained by these pests will be reduced, and the otherwise low yield of cane per acre increased.

The Tongaat Sugar Company have enjoyed another good year. The sales of sugar have increased by £15,000 and the net profit comes out at £17,600 as against £11,400. The Ordinary Share dividend has been declared at 7½ per cent., the highest ever received.

REFRACTOMETER STUDIES.

By F. G. Wiechmann.

My attention was first called to the use of the refractometer in sugar house work by Mr. Hugh Main, at the Meeting of the International Commission for Uniform Methods of Sugar Analysis at Bern, Switzerland, on August 7th, 1906.

Before taking up this refractometer work, however, and in order to gain a satisfactory basis of comparison for the determination of the total solids in sugar products, a number of moisture determinations were made on raw sugars and on refined sugars, in respectively, an air-bath wherein the temperature was kept at 100° C., and in a vacuum-stove at 70° C., the vacuum therein being held at about 660 millimetres (26 inches) of mercury.

The data obtained in these tests appear in Tables I. and II.

TABLE I.

Raw Sugars.

No.	Sugar.	Polarization.	Water Determination in Air-bath. T=100° C.	Water Determination in Vacuum. T=70° C.	Difference.
1	2	3	4	5	6
1	1st Beets	94·5	2·42	2·36	·06
2	,, ,,	95·4	1·76	1·66	·10
3	,, ,,	94·8	2·40	2·16	·24
4	,, ,,	94·4	2·48	2·32	·16
5	,, ,,	94·4	2·28	2·14	·14
6	,, ,,	94·5	2·46	2·32	·14
7	,, ,,	95·0	2·06	1·94	·12
8	,, ,,	94·2	2·84	2·78	·06
9	,, ,,	94·9	2·16	2·12	·04
10	,, ,,	95·1	2·14	2·04	·10
11	,, ,,	95·2	1·80	1·74	·06
12	,, ,,	95·0	2·00	1 90	·10
13	,, ,,	95·3	1·84	1·66	·18
14	,, ,,	94·5	1·92	1·80	·12
15	,, ,,	95·2	1·82	1·64	·18
16	,, ,,	94·7	2·44	2·20	·24
17	,, ,,	95·2	2·22	1·98	·24
18	Hawaiian Islands	96·6	0·66	0·54	·12
19	,, ,,	96·3	0·84	0·76	·08
20	,, ,,	96·4	0·82	0·72	·10
21	,, ,,	94·9	1·16	1·08	·08
22	,, ,,	95·4	0·94	0·88	·06
23	,, ,,	96·4	0·96	0·94	·02
24	,, ,,	96·7	0·68	0·50	·18
25	,, ,,	95·2	1·06	0·96	·10

No.	Sugar.	Polarization.	Water Determination in Air-bath. T=100° C.	Water Determination in Vacuum. T=70° C.	Difference.
1	2	3	4	5	6
26	Hawaiian Islands	96·3	0·76	0·66	·10
27	,, ,, ...	95·5	0·94	0·82	·12
28	,, ,, ...	91·3	4·00	3·92	·08
29	Porto Rico Centrifugal..	95·7	1·08	1·04	·04
30	,, ,, ..	95·4	1·18	1·00	·18
31	,, ,, ..	96·2	1·04	0·92	·12
32	,, ,, ..	95·2	1·26	1·10	·16
33	,, ,, ..	94·8	1·60	1·44	·16
34	,, ,, ..	96·1	0·96	0·80	·16
35	Pernambuco	85·3	6·04	5·66	·38
36	,, ...	85·2	5·98	5·60	·38
37	,, ...	86·2	5·80	5·36	·44
38	Java Centrifugals	97·6	0·44	0·34	·10
39	Ilo-Ilo	81·4	4·18	3·84	·34
40	Maceio	86·8	5·80	5·50	·30
41	,, ...	86·6	6·02	5·72	·30
42	Cuba Centrifugals	93·2	2·34	2·18	·16
43	,, ,, ...	93·9	1·66	1·46	·20
44	,, ,, ...	96·0	1·38	1·26	·12
45	,, ,, ...	94·5	1·82	1·56	·26
46	,, ,, ...	95·8	1·22	1·06	·16
47	,, ,, ...	94·6	1·80	1·62	·18
48	,, ,, ...	95·3	1·30	1·14	·16
49	,, ,, ...	94·3	1·74	1·56	·18
50	,, ,, ...	93·7	1·64	1·50	·14
51	,, ,, ...	95·4	1·60	1·44	·16
52	,, ,, ...	92·2	2·36	2·12	·24
53	,, ,, ...	94·2	1·54	1·38	·16
54	,, ,, ...	93·7	1·66	1·46	·20
55	,, ,, ...	95·9	1·76	1·62	·14
56	San Domingo Musco ..	91·3	3·94	3·74	·20
57	Maracaibo Musco.. ..	90·4	4·10	3·88	·22
58	Cienfuegos Molasses....	90·5	2·82	2·46	·36
59	Cuba Molasses	88·5	3·26	3·02	·24
60	,, ,, ...	88·4	4·16	3·88	·28

The average difference of all of these 60 determinations is 0·17 %, this being the amount that the vacuum-stove results are lower than those obtained by drying in an air-bath at 100° C.

The former values would also seem to be the more reliable of the two, for most of these raw sugars are rich in invert sugar and a long-time experience has convinced me that the loss in weight found in drying colonial products—and generally ascribed wholly to the evaporation of water—is in many instances partly due to the decomposition of organic non-sugars.

TABLE II.

Refined Sugars.

No.	Water Determination in Air-bath. T=100° C.	Water Determination in Vacuum-stove. T=70° C.	Difference.	No.	Water Determination in Air-bath. T=100° C.	Water Determination in Vacuum-stove. T=70° C.	Difference.
1	4·22	4·14	0·8	47	4·52	4·30	·22
2	4·50	4·38	·12	48	4·24	3·98	·26
3	4·72	4·66	·06	49	4·52	4·10	·42
4	4·86	4·76	·10	50	4·22	3·86	·36
5	4·84	4·70	·14	51	4·14	3·78	·36
6	4·80	4·62	·18	52	3·84	3·48	·36
7	4·88	4·62	·26	53	3·46	3·12	·34
8	4·66	4·44	·22	54	3·30	2·96	·34
9	4·78	4·42	·36	55	3·92	3·82	·10
10	4·66	4·40	·26	56	3·92	3·82	·10
11	4·54	4·22	·32	57	4·44	4·32	·12
12	3·96	3·66	·30	58	4·86	4·62	·24
13	3·82	3·42	·40	59	4·72	4·54	·18
14	3·38	2·92	·46	60	4·96	4·66	·30
15	3·32	2·96	·36	61	4·64	4·48	·16
16	5·26	4·82	·44	62	5·16	4·84	·32
17	4·70	4·36	·34	63	5·16	4·78	·38
18	4·96	4·56	·40	64	5·06	4·72	·34
19	4·32	3·86	·46	65	5·18	4·80	·38
20	3·94	3·84	·10	66	5·08	4·64	·44
21	4·72	4·58	·14	67	4·98	4·52	·46
22	4·94	4·80	·14	68	4·30	3·86	·44
23	4·18	4·14	·04	69	4·48	4·06	·42
24	4·96	4·78	·20	70	3·68	3·62	·08
25	2·56	2·50	·06	71	4·26	4·06	·20
26	4·02	4·00	·02	72	4·90	4·80	·10
27	4·28	4·18	·10	73	4·34	4·22	·12
28	4·54	4·50	·04	74	4·64	5·58	·06
29	4·70	4·66	·04	75	4·60	4·46	·14
30	4·70	4·52	·18	76	4·62	4·34	·28
31	4·64	4·54	·10	77	4·80	4·48	·32
32	4·60	4·38	·22	78	4·68	4·24	·44
33	4·34	4·10	·24	79	4·54	4·10	·44
34	4·12	3·88	·24	80	4·20	3·88	·32
35	4·30	4·02	·28	81	4·04	3·62	·42
36	4·30	3·98	·32	82	3·52	3·04	·48
37	3·94	3·42	·52	83	3·30	2·74	·56
38	3·38	2·96	·42	84	5·16	5·00	·16
39	3·06	2·68	·38	85	5·38	5·28	·10
40	3·06	2·76	·30	86	5·62	5·54	·08
41	3·90	3·82	·08	87	5·22	5·08	·14
42	4·68	4·56	·12	88	4·54	4·40	·14
43	4·94	4·76	·18	89	4·40	4·28	·12
44	4·62	4·36	·26	90	5·38	5·00	·38
45	4·74	4·62	·12	91	4·84	4·64	·20
46	4·62	4·26	·36				

These refined sugars were of all grades, and ranged in polarization from 96·8 to 83·8.

The results obtained by drying in the vacuum-stove are also in all of these instances lower than those yielded by drying in the air-bath at 100° C. The average difference of these 91 determinations is 0·26%, but as the differences in the higher grade products ranged only within one or two-tenths of one per cent.—the larger differences invariably occurring in the low-grade products—there seems here to be a confirmation of the correctness of the opinion previously expressed, namely, that the results obtained by drying in vacuum and at the lower temperature are more reliable than the values found by drying in an air-bath at 100° C. Therefore, whenever results found by the refractometer are to be compared with moisture-determinations secured by direct drying, the vacuum-stove method (T=70° C. and vacuum 660 millimetres) should be given the preference.

The manner of obtaining the refractometer-determinations in this study differed in no respect from the methods pursued by others. In brief, the work was carried on as indicated by the following directions :—

Method used for Saccharine Solids and Semi-Solids, Sugars, Masse-cuites, Magmas, &c.

Weigh, together with its cover and a stirring-rod, a dish, basin, or crucible, about 5 cm. (2 in.) in diameter and about 4·5 cm. ($1\frac{3}{4}$ in.) deep.

Into this weigh 10·0 grams of the sugar to be examined. Add about 10 cc. hot distilled water and dissolve the sugar completely, using heat if necessary. Cool to standard temperature chosen, viz., 20° C., and re-weigh.

Record these data as illustrated in the following example :—

Sugar, refined :—

(*a*) Dish + cover + rod + sugar	58·4564
(*b*) Dish + cover + rod	48·4564
(*c*) Sugar	10·0000
(*d*) Dish + cover + rod + sugar + water ..	68·2303
(*b*) Dish + cover + rod	48·4564
(*e*) Solution (sugar + water)	19·7739
(*c*) Sugar	10·0000
(*f*) Water added	9·7739

Place a few drops of solution (*e*) between the prisms of the Abbe refractometer, secure a sharp border-line by means of the compensator, as fully explained in the directions which accompany the Abbe-Zeiss refractometer, and take the refractometer readings of the

solution. These readings give the refractive index for the D line directly, but as the refractive index of a liquid is greatly affected by the temperature, it is important that the prisms and the layer of the solution held between them be at the normal temperature chosen (20·0° C.) throughout the observations.

At least six readings by one or several observers should be made and averaged, and of course care should be taken to have the refractometer in perfect adjustment. This is determined either by means of the testing prism which is furnished with each instrument, or by testing the refractive index with pure water (1·330). Should the instrument be but slightly out of adjustment, the necessary correction is most easily made by adding or subtracting such correction from the average of the observed readings of the solution examined; if the adjustment is seriously out, then of course the refractometer must first be put into proper condition.

The method of noting the refractometer readings, and the subsequent calculation, are shown in the following example:—

Testing Adjustment of Refractometer.

Prism at 20° C.

	Observer. A.		Observer. B.
	1·3334		1·3333
	1·3333		1·3334
	1·3333		1·3333
	4·0000		4·0000
Average..	1·3333	Average..	1·3333

Average	1·3333
Pure water	1·3330
Refractometer too high by	0·0003

Refractometer Readings of Sugar Solution.

	Observer. A.		Observer. B.
	1·4177		1·4173
	1·4177		1·4178
	1·4177		1·4178
	4·2531		4·2529
Average..	1·4177	Average..	1·4176

Average	1·4177
Correction	0·0003
Corrected Reading.. ..	1·4174 = 51·28% water.

Hence, in the solution (*e*) there is 51·28% of water, or $\frac{19{\cdot}7739 \times 51{\cdot}28}{100} = 10{\cdot}1400$ grams of water.

In the solution there are	=	10·1400 grams of water.
Water added (*f*)	=	9·7739 ,, ,,

hence, in 10·0 grams of sugar there are 0·3661 grams of water, and therefore the sugar contains $\frac{{\cdot}3661 \times 100}{10} = 3{\cdot}66\%$ water.

Method used for Saccharine Liquids, Liquors, Syrups, &c.

If possible, the refractometer-reading is to be determined on the sample and the percentage of water ascertained directly from the table.

If the sample to be examined is, however, too dark in colour to permit of the taking of direct readings, dilute it one half with water or treat it as suggested in the treatment of saccharine solids and semi-solids, *i.e.*, proceed with a weighed amount of the sample exactly as previously directed.

It will be needless to give here in detail the results obtained in this part of this investigation except to state that the data were very much of a disappointment as far as the hoped-for concordance between the results of the refractometer-method and the drying-out method were concerned.

In the refined sugar products, for instance, the percentages of water found by the refractometer varied from the corresponding values found by the vacuum-drying method by as much as 1%; in 43% of the cases the refractometer values for water were *higher* than the vacuum-stove values; in 57% of the cases *lower* than the latter.

In the examination of syrups the percentage values of water found by the refractometer were *higher* in *all* cases than the corresponding values obtained by the vacuum-stove, and this plus ranged from 1·74% to 2·29%. The agreement between the vacuum-stove results and determinations made by the hydrometer were, on the other hand, satisfactory, for such differences ranged from 0·11% to 0·69% only.

In view of these results it was decided to proceed along different lines and to test the work with the refractometer by making sugar solutions of known strength with sugars of a high grade so as to be able to compare the known values of such solutions with the readings obtained by the refractometer. This work was carried out in the following manner:—

Into a weighed, perfectly clean and dry glass-stoppered flask there was placed a known amount of pure distilled water, having a temperature of exactly 20°C.

The predetermined amount of pure dry sugar to be used, in order to make a solution of known strength, was then weighed out on a dry

glass dish and most carefully introduced into the glass flask, the stopper of the latter replaced at once, and the sugar brought into perfect solution without the application of heat.

The weight of sugar used in preparing such a solution of predetermined strength was calculated as follows :—

$$\left.\begin{matrix}\text{Weight of}\\ \text{water used}\end{matrix}\right\} \times \left\{\begin{matrix}\text{percentage amount}\\ \text{of sugar desired}\\ \text{in the solution}\end{matrix}\right\} \div 100 - \left\{\begin{matrix}\text{percentage amount}\\ \text{of sugar desired}\\ \text{in the solution.}\end{matrix}\right.$$

For instance,

Required a sugar solution of 40% strength.

Mass of water used = 50·000 grams.

$$\frac{50 \times 40}{100 \times 40} = \frac{2000}{60} = 33{\cdot}334.$$

Hence, 33·334 grams of sugar must be used.

Proof :—

	Grams.
Water used .. .. =	50·000
Sugar used .. .. =	33·334
Sugar solution .. .. =	83·334

$$83{\cdot}334 : 33{\cdot}334 :: 100 : x.$$

$$x = 40{\cdot}0\%.$$

A sugar solution of known strength having been thus prepared and the adjustment of the refractometer having, in every instance, been tested at 20°C., a few drops of the sugar solution were placed between the prisms of the refractometer, which were scrupulously kept at 20°C. throughout the readings, and the readings taken by two observers were averaged.

The record of each experiment was kept as illustrated in the following example :—

	Grams.
Sugar used.. .. .. =	10·0000
Water used .. .. =	10·0008
Sugar solution .. .. =	20·0008

Adjustment of Refractometer.

Prism at 20° C.

	Observer. A.		Observer. B.
	1·3335		1·3335
	1·3335		1·3335
	1·3335		1·3335
Average..	1·3335	Average..	1·3335

Average	1·3335
Pure water	1·3330
Refractometer too high by	0·0005

Readings on Sugar Solution.

Prism at 20° C.

Observer. A.	Observer. B.
1·4208	1·4209
1·4209	1·4210
1·4810	1·4209
Average.. 1·4209	Average.. 1·4209

Average	1·4209
Correction	0·0005
Corrected reading	1·4204

and this, according to Main's table* = 49·85% water
50·15% sugar

True Amount of Sugar in Solution.

$$20{\cdot}0000 : 10{\cdot}0 :: 100 : x.$$
$$x = 50{\cdot}00\%.$$

	Per cent.
True amount of sugar in solution	50·00
Amount of sugar indicated by refractometer ..	50·15
Refractometer result too high by	0·15

Four series of experiments were made most carefully in the manner described. The analytical data of the sugars used were as follows:—

	Series. I. Per cent.	II. Per cent.	III. Per cent.	IV. Per cent.
Polarization....	99·55	99·85	99·49	99·47
Water..	0·006	0·03	0·055	0·03
Ash..	0·0036	trace	0·0045	trace
Copper reducing substances ..	——	——	present	present

The experimental data obtained are given in the following table:—

Series No.	Experiment No.	Percentage of solids in the solution examined.	Actual per cent. of Sucrose based on Pol. Test.	Index of Refraction of this solution, made and observed at 20° C.	Percentage of sugar assigned to the index of refraction observed by table of Hugh Main.†	Tolman & Smith.‡
I.	1	8·99	8·95	1·3466	9·40	9·30
I.	2	20·62	20·53	1·3653	20·95	21·00
I.	3	29·99	29·85	1·3816	30·30	30·35
I.	4	40·00	39·82	1·4004	40·35	40·35
II.	5	40·00	39·94	1·4004	40·35	40·35
II.	6	50·00	49·92	1·4208	50·35	50·40
II.	7	59·98	59·81	1·4431	60·50	60·50
III.	8	5·00	4·97	1·3404	5·25	5·15

* *Inter. Sugar Journal*, 1907, Vol. 9, p. 481.
† *Inter. Sugar Journal*, 1907, Vol. 9, page 481.
‡ *Journal American Chem. Society*, Vol. 28, page 1476.

Series No.	Experiment No.	Percentage of solids in the solution examined.	Actual per cent. of Sucrose based on Pol. Test.	Index of Refraction of this solution, made and observed at 20° C.	Percentage of sugar assigned to the index of refraction observed by table of Hugh Main.	Tolman & Smith.
III.	9	10·00	9·95	1·3479	10·25	10·15
III.	10	19·98	19·88	1·3640	20·20	20·20
III.	11	30·00	29·85	1·3815	30·25	30·30
III.	12	40·04	39·84	1·4003	40·30	40·30
III.	13	50·00	49·75	1·4204	50·15	50·20
IV.	14	5·00	4·97	1·3403	5·20	5·07
IV.	15	10·00	9·95	1·3477	10·10	10·00
IV.	16	20·00	19·89	1·3642	20·30	20·29
IV.	17	30·00	29·84	1·3813	30·15	30·17
IV.	18	40·00	39·79	1·3999	40·10	40·10

In all of the experimental work involved in this study the writer has had the valued assistance of Mr. James E. Kelly, to whom he would also here express his appreciation.

It will be recalled that some of the investigators who have given their attention to the use of the refractometer have noted considerable differences in the results which they obtained on the examination of sugar-house products by the refractometer and by dessication.

Thus, Prinsen Geerligs (*Deutsche Zuckerindustrie*, 1908, Vol. 33, p. 50) states that, in the analysis of the end syrups of 89 factories the value found by the refractometer was in 55 cases higher than the value found by dessication, and in 34 cases lower than this latter value.

	Per cent.		Per cent.
In 16 instances the difference was	+ 0·00	to	0·25
In 10 ,, ,, ,, ,,	+ 0·25	,,	0·50
In 19 ,, ,, ,, ,,	+ 0·50	,,	0·75
In 10 ,, ,, ,, ,,	+ 0·75	,,	1·00
In 6 ,, ,, ,, ,,	+ 1·00	,,	1·25
In 10 ,, ,, ,, ,,	+ 1·25	,,	1·50
In 7 ,, ,, ,, ,,	+ 1·50	,,	1·75
In 8 ,, ,, ,, ,,	+ 1·75	,,	2·00
In 3 ,, ,, ,, ,,	+ 2·00	,,	2·25

The writer's experience with lower-grade sugar products has been similar. However, in the four series which have been here detailed, and which were made with high grade sugars, the sources of error which affect refractometer determinations of low-grade products do not exist. Moreover, as these observations were made on solutions of *known* composition, there could be no uncertainty caused by having to compare the results found with the results of any other analytical process which might be entitled to more or less credibility.

Comparing the differences between the percentage-amounts of sugar *assigned* by the table of Hugh Main and the *actual* amounts of sugar present in the solutions examined, it will be seen that:—

Series		Percentage of Sugar as found by refractometer (using Main's table) is in excess of sugar actually present in the solutions, by. Per cent.
Series I.		
	1	0·45
	2	0·42
	3	0·45
	4	0·53
Series II.		
	5	0·41
	6	0·43
	7	0·69
Series III.		
	8	0·28
	9	0·30
	10	0·32
	11	0·40
	12	0·46
	13	0·40
Series IV.		
	14	0·23
	15	0·15
	16	0·41
	17	0·31
	18	0·31

The average difference is 0·39 %.

Were these differences due to errors of observation they would not all lie in one direction, as they do. Moreover, these differences are too great to be ascribed to the fact that the figures in the fourth decimal place have had to be *estimated*, instead of being directly observed, although there is no doubt that the use of a refractometer constructed to permit of the direct reading instead of the estimating of these values, would enhance the accuracy of the refractometer method considerably, for a difference of two in the fourth decimal place of the index of refraction observed conditions a difference of one-tenth per cent. in the result.

It would thus appear to follow that if the refractometer is to find a permanent place in the sugar laboratory, it will be necessary to prepare a table of the refractive index values of *chemically pure* sucrose solutions, at some standard temperature, say at 20°.

ON THE ESTIMATION OF SUGAR IN BAGASSE.

By H. Pellet.

The question of the determination of sugar in bagasse by means of the Zameron apparatus has been discussed from time to time in different journals. In agreement with our own conclusions, it is held by certain workers that a single treatment of the bagasse with water, under the prescribed conditions ($\frac{1}{4}$ hour duration), does not give the maximum extraction of sugar. The exhausted bagasse, from which the liquid has been decanted, when again crushed yields a liquid which is still rich in sucrose. Again, if the determination be carried out by repeated extraction in the Zameron apparatus there is likewise a difference, and a higher result is obtained by this means than by

the single extraction method. These differences are not constant, but the reason of this is not difficult to understand. The greater the sub-division of the material examined in the single extraction determination, the less will be the difference observed, and the nearer the results will approach those obtained by means of the Zameron apparatus. This division of the bagasse, we may remark, is difficult to carry out in a satisfactory manner and demands considerable care and time. We have observed differences varying from 0·2 to 0·6 per cent. of the bagasse, amounts which are of importance when the quantity of cane worked is taken into consideration.

Mr. Prinsen Geerligs has suggested an explanation of these results obtained by means of the Zameron apparatus. He points out that the repeated treatment of the bagasse by boiling water is capable of causing the formation of polarizing bodies which are not precipitable by basic lead acetate. We wish, however, to state that this reaction only takes place after a period of three hours, whereas in an ordinary determination in the Zameron apparatus the treatment of the bagasse does not exceed 40 minutes and can even be shortened to 30 minutes. Further, such a transformation into substances influencing polarized light should be more or less continuous; when, however, the estimation is carried out by means of the Zameron apparatus in the manner indicated, it is found that after the required number of extractions the polarimetric reading indicates zero.

The results of other investigators have, moreover, shown that the figures given by the alcohol method in the Soxhlet apparatus were not trustworthy, being about the same as those obtained by simple extraction with water. It has also been proved that the bodies produced by the treatment of the sugar cane fibre in this manner exert a levo-rotatory action on polarized light. Again, to effect their transformation it is necessary to prolong the treatment for some hours, in fact, to an extent that is not used in carrying out ordinary determinations by the Zameron apparatus, when the tendency is to decrease the duration of the series of digestions to its minimum extent, with the object of obtaining results as quickly as possible.

We maintain that our previous results, confirmed by those obtained during the 1907-1908 campaign in Egypt, show that under the ordinary conditions as to division of sample a single treatment lasting 15 minutes does not always give all the sugar; and that the Zameron apparatus gives the correct amount of sugar in the bagasse, provided the precautions, which have been indicated either by us or by other workers, with the object of avoiding inversion of sugar and of precipitating the extracted foreign substances, are carefully observed.

In conclusion, we hope that those having the Zameron apparatus at their disposal will investigate this question, and will be able to confirm our opinion that the method of estimating sugar in exhausted bagasse by single extraction always gives low results.

DETERMINATION OF SUGAR IN BEETROOT SUGAR PRODUCTS, ESPECIALLY IN DRIED ROOTLETS AND DRIED PULP.

By J. Robart.

Having had occasion to carry out a large number of determinations of the amount of sugar in dried beet rootlets and pulp during the last campaign, we were lead to devise a simple and practical method of estimating the volume of the marc and of the lead precipitate in order to make the necessary correction for the polarimetric readings.

We found that when using the method recommended by the German administration there were certain sources of error which could not be overcome however carefully the determination was carried out. It is obvious that in an analytical process the possibility of error is increased as the amount of the material undergoing examination is decreased, and it is for this reason that the German method, in which the quarter normal weight of material is digested in a 200 c.c. flask and afterwards polarized in a 400 mm. tube, gives somewhat uncertain results.

The method which we have worked out is simple in theory and readily carried out in practice.

If twice the normal weight of pure sucrose is dissolved in 200 c.c. of water and this solution polarized in a 200 mm. tube it is evident that the reading will be 100° V.

Suppose now an inert body occupying 4 c.c. is placed in the flask containing the sugar solution before making up to bulk, and the same operation repeated, the polarization will read :—

$$\frac{100 \times 200}{200 \text{ c.c.} - 4 \text{ c.c.}} = 102{\cdot}04^\circ.$$

When, on the other hand, this value, 102·04, is known it is easy to calculate the volume occupied by the inert substance in the flask. Thus:

$$200 \text{ c.c.} - \left(\frac{200 \times 100}{102{\cdot}04}\right) = 4 \text{ c.c.}$$

Our experiments have convinced us that there is a perfect comparison between the inert body, such as we have used for an example, and the marc and lead precipitate.

We therefore operate in the following way: A stock of refined sugar is obtained and transferred to a well-stoppered bottle; the normal weight of this sugar, *i.e.*, the amount which when dissolved in 100 c.c. of water and polarized in a 200 mm. tube reads exactly 100° is next determined.

Half the normal weight of the material under examination is placed in a 200 c.c. flask; into another flask of the same capacity, the same amount of material, together with the normal weight of the

refined sugar, is introduced. Basic lead acetate, and a sufficient quantity of water to bring the contents of the flasks to a light yellow colour, are then added. Both flasks are placed in a water-bath at 85° C. for one hour, cooled, and made up to bulk. They are now stoppered, well shaken, and replaced in the water-bath at 85° for 20 minutes, after which their contents are allowed to cool gradually, filtered, and polarized. It is very necessary that throughout the above-described operations the flasks should be frequently shaken.

If now for example, the polarization of the half normal weight of a sample of dried rootlets is found to be 24·8°, and that of the half normal weight together with the normal weight of refined sugar to be 127·0°, knowing the polarization of the normal weight of pure sugar, we can calculate the volume occupied by the solution as follows:

$$\frac{200 \times 100}{127{\cdot}0 - 24{\cdot}8} = 195{\cdot}7 \text{ c.c.}$$

The volume occupied by the marc and lead precipitate is: $200 - 195{\cdot}7$ c.c. $= 4{\cdot}3$ c.c., and the corrected value for the percentage of sugar in the sample of dried rootlets therefore becomes:

$$\frac{(24{\cdot}8 \times 2)\,(200 - 4{\cdot}3)}{200} = 48{\cdot}5.$$

The results which we have obtained by this method agree very well with those obtained by making direct determinations. This is shown by the following table:—

Polarization of $\frac{1}{2}$ *n.w.* of rootlets in 200 c.c. flask and 400 mm. tube.	Polarization of $\frac{1}{2}$ *n.w.* of rootlets + *n.w.* of sugar in 200 c.c. flask and 400 mm. tube.	Volume occupied by marc and ppt., calculated from the two polarizations.	Volume found by direct determination.	Sugar by aqueous extraction method.	Sugar by the new method.
24·8°	127·0°	4·3 cc.		49·0	48·5
25·0	127·4	4·7		49·1	48·8
26·2	128·4	4·3	4·5 cc.	51·6	51·3
25·3	127·8	4·9		49·4	49·5
24·9	127·4	4·9		48·2	48·7

Bulletin de l'Association des Chimistes de Sucrerie.

Messrs. Watson, Laidlaw & Co., Ltd., were awarded two Grand Prizes, three Diplomas of Honour, and three Gold Medals at the Franco-British Exhibition, for an exhibit of Centrifugal Machines for sugar and chemicals, comprising belt-driven, water-driven, and electrically-driven machines.

EXPLANATION OF THE OCCASIONAL ABNORMALLY HIGH QUOTIENT OF PURITY OF SOME SUGAR CANE JUICES.

By H. Pellet.

Some years ago Mr. Prinsen Geerligs pointed out in an article in the *International Sugar Journal* (1900, 147) that certain cane juices which had come under his observation were of an abnormal character. The polarization of these juices was so high that the calculated sucrose content exceeded the figure for any substance as indicated by the Brix hydrometer. This phenomenon was presumed to be due to the presence of polarizing bodies, other than sucrose, having a remarkably high dextro-rotatory power.

Mr. Geerligs has more recently (this *Journal*, 1908, 128) taken the view that a possible explanation of the problem of these abnormally high polarizations might be offered by the presence of alcohol, or of a similar volatile body of low specific gravity, in the juice. This hypothesis, he points out, receives some confirmation in the fact that such juices, when evaporated to the state of a syrup, revert to their original normal character, showing ordinary quotients of purity, and indicating true Brix readings. It was further pointed out by Mr. Geerligs in this article that alcohol is not an uncommon constituent of mill juice, and that the cane from which the juices mentioned in the 1900 article had come had suffered from stagnation in the early period of their growth. He then considered the possibility of the formation of alcohol being due to a ferment, *saccharomyces apiculatus*,* which has the property of differentiating between glucose and sucrose, fermenting only the former without having any action on the latter. Went and Geerligs have observed that the fungus of the pineapple disease or black rot, *Thielaviopsis ethaceticus*, is capable of forming ethyl acetate, as well as alcohol, from sugar-containing media, and Mr. Geerligs himself is of the opinion that it is not impossible for an intercellular fermentation to set in during the transport and storing of cut cane in a hot climate causing in this way the mill juice to contain more or less alcohol.

Nevertheless, it is to be noted, that although Mr. Geerligs has endeavoured to identify the presence of alcohol in the juices from cane which has been attacked by black rot, he has not, up to the present time, been able to do so.

Moreover, assuming the presence of a ferment capable of eliminating the glucose without acting on the sucrose, it is evident that the purity of the resulting product will be raised; but the purity whilst being increased by the concentration in this way will be

* Other ferments having the same property as *S. apiculatus* have been described by Gayon and Dubourg and by Paisault.—H. P.

further modified by the disappearance of the glucose, in that this body having been eliminated is no longer capable of increasing the Brix value or of masking the sucrose by exerting a levo-rotatory action on being polarized. Again, if the cane had undergone a general fermentation its sucrose being attacked with the formation of alcohol, the purity before heating would be high, but after expelling the alcohol the purity of the juice would be more or less low according to the amount of alcohol formed during the fermentation.

Mr. Geerligs, however, stated in his article that after concentration these juices become quite normal.

Our explanation of the cause of the abnormally high quotients observed is as follows. According to the quality of the cane and the manner in which it has been treated the juices obtained are in a more or less viscous condition, and consequently the air which has become entangled in the juice during the process of extraction is held by the liquid in the state of an emulsion and is incapable of escaping even after having stood for a comparatively long time. The Brix reading will therefore be more or less influenced by the presence of this emulsified air; it will however pass to its normal value when the air is expelled by heating or by other suitable means.

The presence of air in an emulsified condition in sugar juices is not a generally recognised fact although its importance for the beet sugar industry has been emphasized from time to time by certain investigators. Pagnoul, 25 years ago, pointed out the necessity of submitting juices to the action of the vacuum apparatus for the purpose of withdrawing the air which they retained even after having stood for 12 hours. Air plays a very great part in the determination of the density of molasses, and we are able to show that the extraordinary results which have been obtained by certain workers can readily be explained in this way. Sometimes the air cannot be withdrawn *in vacuo*, nor by heating for several hours. We intend to make these latter remarks the subject of a future paper.

We have observed that some beetroot juices retain air in a more or less persistent degree according to the conditions of extraction which have prevailed, and that the purity of such juices is capable of rising to as high as 97-98 instead of 87-88, the value obtained under the ordinary conditions of working.

Therefore, since it has not been possible to affirm the presence of alcohol, or of an analogous body lighter than water, in those juices showing very high quotients of purity, we are of the opinion that the explanation of the problem is to be found in the presence of a more or less quantity of air, which is retained by the liquid in the state of an emulsion and which is not eliminated even after standing for a relatively long time.

GERMANY.

Results of the Campaign of 1907-08.

The number of factories at work during the season just closed was 365, a decrease on the previous campaign of four. The decrease in the number has been constant of late years, and it is stated that only 360 will open the new campaign. The new conditions, following on the Brussels Convention, have forced matters to a head, and amalgamations and concentrations are now the order of the day.

The area planted with beets amounted to 448,493 hectares, as compared with 444,183 in 1906-07. This slight increase was, however, discounted by a diminished output per hectare of 30·1 tons as compared with 31·7 in the previous campaign. The quantity of beets worked up amounted to 13,491,424 metric tons, as compared with 14,186,536 tons in 1906-07.

The total sugar production in raw sugar value has been as follows:—

1907-08. Metric Tons.		1906-07. Metric Tons.		1905-06. Metric Tons.
2,135,979	....	2,242,046	....	2,314,779

The yield obtained was thus 14·93 per cent., as compared with the previous 14·97 per cent.

FRANCE.

Results of the Campaign of 1907-08.

The results of the French sugar campaign of 1907-08, as set forth in the *Journal des Fabricants de Sucre* show that there were only 255 factories in operation as compared with 273 in 1906-07, and 292 in 1905-06, a further decrease of 18. The blame for this is laid to the door of excessive taxation.

The area under beet cultivation has been unofficially estimated at 201,000 hectares, as compared with the official figure of 207,170 hectares in 1906-07, a decrease of 3 per cent.

The production of sugar expressed in refined amounted to 656,832 metric tons as compared with 682,851 tons in 1806-07 and 984,672 tons in 1905-06. This deficit following on the heavy drop since 1905-06 is attributed in part to reduced cultural returns. The yield in sugar per cent. of beets was 12·00% as compared with 12.47% in the preceding campaign.

The Board of Trade announce the imposition of a Customs duty on cotton bags for sugar when entering Cuba. All bags for packing sugar, made of cotton tissue, plain and without figures, or twilled, will be liable in future to a tax of nine cents per kg. It is necessary that such bags be marked with the name of the sugar mill for which they are intended and the place where the same is located.

ABSTRACTS, SCIENTIFIC AND TECHNICAL.*

Improved Method of Juice Purification. *H. Steffen. Sucr. Indigène.* *1908, 72, 214-218.*

The raw juice is first treated with lime to the amount of 0·6-1·0 per cent. on the weight of beets worked, and heated to 70° C.; air for 15 minutes, or ozone or ozonized air for 5-10 minutes, is then blown through the liquor.

By operating in this way, the author states, it is found that the small amount of lime used in defecation is sufficient to effect the ready combination of the non-sugar, and especially of the colouring matters contained in the juice; that the scums are readily filtered and washed; and that the resulting juice is well decolorized and of high purity.

Technical Utilization of Organic Non-Sugar. *F. Ehrlich. Chem. Centr., 1908, 15, 1271-1274.*

In an interesting discussion on this subject the author points out that molasses contains up to 7 per cent., and the spent wash from molasses up to 17 per cent. of betain, which can be easily and completely extracted by treating with alcohol, evaporating the solution obtained to dryness, and adding hydrochloric acid to the resulting syrup.

Betain hydrochloride is stable in contact with air, but when boiled with water it readily splits up into betain and hydrochloric acid. It is on account of this property that the salt has already found a somewhat extensive application in medicine under the names of "acidol" and "acidol-pepsin."

It is suggested that it may further find use in analytical work as a standard substance in acid and alkali titrations.

Mucilage and Gum Formation in Sugar Factories. *A. Schöne. D. Zuckerind., 1908, 33, 699-702.*

An exhaustive study of the micro-organisms causing mucilaginous and gummy formations in raw sugar factories shows that, besides *Leuconostoc*, there are certain rootlet bacteria which must also be considered as active agents in effecting the fermentation; these are capable of acting in this way either alone, or with *Leuconostoc*, or in symbiosis with some thermophilic yeasts.

Gonnermann's *Myxococcus betae* is believed by the author to be identical with *Leuconostoc*, and his *Myxobacillus betae* with Claassen's *Semiclostridium*.

Diffusion Temperature. *A. Hinze. Centr. Zuckerind., 1908, 16, 1294-1295.*

From a series of experiments carried out by the author it is shown that, in agreement with the results of certain other workers, the so-called "hot" method of diffusion has all the advantages claimed for it with the exception of that of the supposed better coagulation of the albumenoids; when the process is properly carried out no loss of sugar by inversion can be detected.

Cause of the Dark Colour of Beet Juice. *H. Gonnermann. Sucr. Indigène, 1908, 72, 196.*

After a long study of this question the author concludes that the dark coloration is not due, as is generally supposed, to the homogentisic acid produced by the action of tyrosinase upon tyrosine, but rather to the action of tyrosinase and iron salts upon pyrocatechol. Tyrosinase acts as an oxydase, and consequently as soon as the pyrocatechol and iron salts come in contact with air the dark colour develops. The author has been successful in isolating small amounts of pyrocatechol by crystallization from beet juice. It is pointed out that Lippmann has already found this body in the leaves of the sugar beet and also in several samples of raw sugar.

Precipitation of Sugars by Cupric Hydroxide. *S. Yoshimoto. Zeitsch. Physiol. Chem., 1908, 56, 425-445.*

The behaviour of dextrose, levulose, galactose, arabinose, sucrose, maltose, raffinose, xylose, and arabinose towards alkaline cupric hydroxide solutions has been studied.

Solutions containing definite molecular proportions of the sugar and cupric hydroxide were mixed together, and the action of increasing amounts of sodium hydroxide solution on the precipitation of the different sugars was observed.

It was found that in each case there was a point at which the maximum amount of sugar was precipitated, but that the quantity of sodium hydroxide necessary to produce this effect was different for each of the sugars examined.

These results in the case of dextrose are capable of practical use as a means of identification, but in the case of all the other sugars experimented upon they are not applicable.

Inversion of Cane Sugar by Invertase. *C. S. Hudson. Jl. Amer. Chem. Soc., 1908, 30, 1564-1583.*

A series of erroneous conclusions as to the laws governing the inversion of cane sugar by invertase has, on account of the neglect of the mutarotation of the invert sugar, become widely accepted. These conclusions are directly opposed to the results of the well-known

work of O'Sullivan and Tompson, and the author's experiments recorded in the present paper show clearly that these results are correct.

He has extended their work. Invertase does not affect the rate of mutarotation, but acids accelerate it strongly. The action of invertase is very greatly accelerated by the addition of minute traces of acid to the neutral solution; additional small amounts of acid were however observed to have no further effect. The inversion of cane sugar by invertase is accurately proportional to the concentration of the invertase in both dilute and concentrated sugar solutions.

METHOD FOR THE DETECTION OF RAFFINOSE. *R. Ofner. Sucr. Indigène, 1908, 72, 196.*

The details of the proposed method are as follows: 50 grms. of the sugar under examination are treated for 15 minutes with 150 c.c. of absolute methyl alcohol together with a few drops of a solution of potash alum. The mixture is filtered, washed with absolute methyl alcohol, and the filtrate and washings evaporated to the consistency of a syrup. This is now treated with dilute (3 per cent.) sulphuric acid, and allowed to stand for three hours on the water-bath. After neutralization with barium carbonate, and decolorization with animal charcoal, the liquid is filtered and concentrated to half its bulk. Two volumes of 96 per cent. alcohol and 1 cc. of β—Methyl-phenyl-hydrazine solution are then added, the mixture warmed on the water-bath for half an hour, allowed to cool gradually, and finally placed in a freezing mixture, being agitated from time to time by means of a glass rod. At the end of about two hours, if raffinose is present in the sample being tested, galactose methyl-phenylhydrazone separates out in the form of brilliant silky needles which, after washing successively with water, alcohol, and ether, should be found to have a m.p. of 180-183° C. If but a small amount of raffinose be present in the sugar, precipitation may be induced by sowing the liquid with 2-3 mgrms. of the hydrazone obtained in a previous operation.

SIMPLE METHOD FOR THE DETERMINATION OF SUGAR IN SCUMS. *F. Herles. Listy Cukrovarn., 1908, 501;* through *Bull. Assoc. Chim. Sucr. et Dist., 1908, 26, 196-197.*

26·048 grms. of the sample of scums are mixed with a 20 per cent. solution of normal lead acetate; the milky liquid thus formed is poured into a flask graduated to 105 c.c. and made up to bulk with the normal lead acetate solution. The contents of the flask are now shaken vigorously for a time, filtered, and polarized.

A portion of the normal lead acetate on coming in contact with the free lime of the scums is decomposed and lead hydrate thrown down; this afterwards dissolves in the excess of the normal acetate giving a

solution of the basic salt which is capable of serving as a defecant. The quantity of lead solution added must be so measured that one molecule of lime corresponds to two of normal lead acetate, and the author has determined that for the normal weight of ordinary scums the average amount of quicklime present necessitates 4·11 grms. of normal lead acetate. The same weight of scums contains on an average 50 per cent. of insoluble matter, occupying a volume equal to about 5 c.c., so that allowance must be made to this extent. The volume remaining for the lead solution is therefore 105 — (13·024 — 5) = 86·976 c.c., and in this volume 14·11 grms. of normal acetate are to be dissolved; this gives 16·2 grms. per 100 c.c., and an excess of the reagent, say 20 per cent. is not harmful.

The results obtained by working according to this method are stated to agree well with those obtained by means of the acetic acid process.

Determination of Sugar in Molasses Cattle Food. *F. Herles.* *Böhm. Zeitsch. Zuckerind., 1908, 32, 626.*

The half or normal weight of the sample is washed into a polarization flask with warm water, 10 c.c. of lead acetate added, and the mixture allowed to stand for quarter of an hour; after cooling, the contents of the flask are made up to bulk, shaken, filtered, and polarized.

A second determination is now made. The same weight of material is taken, but in this case the half or normal weight of pure sugar is also added to the flask; the above operations are then repeated.

The second reading will exceed the first, after making allowance for the polarization of the pure sugar added, in proportion to the volume occupied by the exhausted cattle food and the lead precipitate, and the necessary correction to this extent must accordingly be made.

This method has been used by the author for the past ten years for controlling the manufacture of all kinds of molasses cattle food, and has been found to give trustworthy results.

Estimation of Alcohol in Fermented Liquids. *W. Antoni.* *Jl. Amer. Chem. Soc., 1908, 30, 1276-1278.*

The following method has been found to be both rapid and accurate:—The alcoholic liquid is measured in a special pycnometer having a capacity of 50 c.c., and two side tubes 8 cm. long and 1·5 and 0·75 mm. bore respectively. It is then transferred to a distillation flask, and the pycnometer rinsed out with distilled water by means of a special arrangement; the distillation flask is now attached to the upper end of a spiral condenser, the pycnometer connected with the lower end, and the alcohol distilled over. At the end of the operation the pycnometer is disconnected and almost filled with water;

after its contents have been brought to the standard temperature it is finally adjusted and weighed.

In order to avoid a correction for the temperature and pressure changes of the atmosphere, a tare of approximately the same weight and volume as the pycnometer filled with water at the standard temperature should be used.

Influence of Cross- and Self-fertilization upon the Progeny of the Mother Beet. *K. Andrlik, V. Bartoš, and J. Urban. Zeitsch. Zuckerind. Böhm., 1908, 32, 373-387.*

Summarizing, the authors state that their investigations have demonstrated that a cross-fertilization of the mother beet is capable of taking place with the breeder at a distance of about 30 cm. from the other mother beets, and that this is shown by a marked change in certain qualities of the descendants, more particularly in the sugar content, but also in the character of the leaves and in the weight. To obtain a proper indication of the influence of the cross-fertilization it is necessary to take into account the power of hereditary transmission of the mutually engaging sexes of the mother beet, and also external influences such as the action of various pests and differences in the conditions of vegetation.

Taking into account the factors considered by the authors, the influence of cross-fertilization is capable of varying the sugar content of the descendant to the extent of from 16 to 53 per cent. The descendants of self-pollenized mother beets which are rich in sugar always weigh less than those of mothers containing little sugar. The weight of cross products is usually about the mean of the weights of the descendants of self-fertilization.

Presence of Vanillin in the Sugar Beet. *M. Pakulski. D. Zuckerind.;* through *Bull. Assoc. Chim. Sucr. et Dist., 1908, 25, 1085.*

During the past campaign a strong odour of vanillin was noticed in certain Russian beet sugar factories. The presence of this body has previously been identified in beets worked after a particularly dry summer. Stammer noticed that the smell was readily developed when beets were dried by powdered lime. Schreibler isolated vanillin from beet syrups by extraction with alcohol; Lippman however was the first to actually separate it from the root.

Vanillin is the active constituent of the vanilla bean pod, which contains 1·5-2·5 per cent. of it. It can be synthesised from coniferin by first oxidizing with chromic acid, then hydrolysing the intermediate product thus formed by acids or emulsin to vanillin and dextrose.

A New Crystalline Sugar. *G. Bertrand. Comp. rend., 1908, 147, 201-203.*

A new sugar, *Perseulose*, has been prepared by oxidizing perseit with a vigorous culture of sorbose bacteria (*B. xylinium*). It crystallises like dextrose, is sweet, and has the formula $C_7H_{14}O_7$. It is sparingly soluble in cold, but freely in hot, strong alcohol. It is decomposed on heating; on the Maquenne block its melting point was determined to be 110—115° C. For its copper reducing power the value 157·3 was obtained, as against 177·8 of dextrose. Its optical rotation is $[\alpha]_D = -81$. It shows mutarotation. With phenylhydrazine it yields a crystalline phenylosazone which melts at 233° C.; as this body is very slightly soluble in methyl or ethyl alcohol its isolation serves as a means of identifying the sugar in admixture with others.

Perseulose is the first heptatomic reducing sugar produced by the action of the living cell which has hitherto been isolated.

Determination of Potash in Soils by the Cobaltic Nitrite Method. *W. A. Drushel. Zeit. Anorg. Chem., 1908, 59, 97-101.*

A weighed portion of the soil is treated on the water-bath with 20 per cent. hydrochloric acid. The excess of acid is removed by evaporation, and the bases separated by adding sodium carbonate, or ammonia and ammonium oxalate. After filtration, the ammonium salts and organic matter are expelled by evaporating the solution to dryness and gently heating the residue. The alkalis are dissolved in water acidulated with acetic acid; this liquid is evaporated almost to dryness and the pastry mass obtained mixed with cold water, then filtered through asbestos. The precipitate is washed with sodium chloride solution and treated with excess of hot dilute potassium permanganate solution. The latter is destroyed by standard oxalic acid solution, the excess of which is determined by titration with standard potassium permanganate.

Estimation of Sugar. *I. Bang. Biochem. Zeitsch. 1908, 11, 538-540.*

Further particulars of the author's method for the determination of reducing sugars are here given, and Jessen-Hansen's article (this *Jl.*, 1908, 461) discussed.

True and Apparent Purity. *J. Weisberg. Bull. Assoc. Chim. Sucr. et Dist., 1908, 25, 944-946.*

The author has previously published tables giving the factors by which the apparent purity of beetroot juices must be multiplied in order to obtain the corresponding true purity. In the present article the accuracy of these tables is demonstrated by a series of examples.

Other subjects are:—

SUGAR AS A FOOD IN THE ARMY. *L. Landouzy.* *Revue Scient.*, *1908*, *10*, *290-296*; and *ibid.*, *1908*, *11*, *333-338*.

ESTIMATION OF SULPHUROUS ACID IN FOOD PRODUCTS. *L. Padé.* *Annal. Chim. Anal. et App.*, *1908*, *13*, *299-301*.

"LEAD VALUE" OF MAPLE PRODUCTS. *A. P. Sy.* *Jl. Amer. Chem. Soc.*, *1908*, *30*, *1611-1616*.

ROESE AND ALLEN-MARQUARDT METHODS FOR THE DETERMINATION OF FUSEL OIL. *W. L. Dudley.* *Jl. Amer. Chem. Soc.*, *1908*, *30*, *1271-1276*.

SPECIFIC GRAVITY OF SUGAR CRYSTALS. *G. Fouquet.* *Bull. Assoc. Chim. Sucr. et Dist.*, *1908*, *26*, *176-177*.

STUDY ON THE SPECIFIC GRAVITY OF AQUEOUS SUGAR SOLUTIONS. *G. Fouquet.* *Bull. Assoc. Chim. Sucr. et Dist.*, *1908*, *26*, *160-176*.

DEPOLYMERIZATION OF THE SUGARS. *C. Neuberg.* *Biochem. Zeitsch.*, *1908*, *12*, *337-341*.

ACTION OF ZINC DUST ON GLUCOSE AND FORMALDEHYDE. *W. Löb.* *Biochem. Zeitsch.*, *1908*, *12*, *78-96*.

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. THOMPSON, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; 77, Market Street, Bradford; and 322, High Holborn, London.

ENGLISH.—APPLICATION.

18703. J. McNEIL and C. McNEIL, Glasgow. *Improved roll for sugar cane mills.* 7th September, 1908.

ABRIDGMENTS.

24503. Dr. B. HAFNER and F. KRIST, Vienna, Austria. *Improved manufacture of fermentable sugar from materials containing starch or cellulose.* 5th November, 1907. This invention relates to a process for the production of directly fermentable sugar from materials containing starch or cellulose by the action of the electric current, pressure and heat, which process consists in subjecting to the action of the electric current the comminuted material mixed with water only and without any preliminary treatment with chemicals or any addition of acids or salts, under a pressure of at least two and a half atmospheres and at a temperature of over 100° C.

25851. H. W. AITKEN, Glasgow. *Improved preparatory breaking rolls for sugar cane mills.* 22nd November, 1907. This invention relates to a roll for a sugar cane mill having zig-zag ridges with intervening channels extending around its circumference, the zig-zag ridges and channels on one half of the roll extending in reverse

direction to those on the other half, and projections in the space between the middle rows of opposite hand channels.

28350. J. McNeil and C. McNeil, Govan, Lanark. *Improvements in connection with sugar cane mills.* 24th December, 1907. This invention relates to a sugar cane mill roll of the type having formed circumferentially on its surface ridges or teeth with intervening channels, with a series of short zig-zag grooves extending longitudinally from end to end of the roll and so spaced apart around the circumference of the roll that there is always a portion of one of the series of grooves opposite the point where two rolls intermesh.

28573. J. McNeil and C. McNeil, Govan, Lanark. *Improved roll for sugar cane mills.* 30th December, 1907. This invention relates to sugar cane mill rolls of the type in which pairs of rolls have intermeshing ridges arranged in longitudinal zig-zags, or in which such ridges upon one roll intermesh with counterpart recesses upon the other, with grooves formed across each zig-zag row of ridges or through the parts of the roll's surface intervening between the recesses.

GERMAN.—Abridgments.

199935. Maschinen und Werkzeugfabrik Akt.-Ges. vorm. August Paschen, of Cöthen, Anhalt. *A device for closing the lower manhole in diffusers.* 7th April, 1907. This device comprises a lever which is flexibly attached to a fixed point by means of a vertical link and presses the cover against the bottom of the diffuser, being arranged horizontally or approximately horizontally, and is flexibly connected with a screw spindle running up the side of the diffuser and capable of being rotated by means of a handle.

199936. Apollo Geiger, of Munich. *A process for boiling down solutions to crystallization in vacuo, more particularly for the sugar manufacture.* 7th May, 1907. In this process a liquid is employed as heat transmitting medium, with the object of easily avoiding too strong a local evaporation and the formation of false crystals caused thereby.

200145. Farbenfabriken vorm. Friedr. Bayer & Co., of Elberfeld. *Process for making soluble starch by means of acids.* 6th March, 1907. This process consists in allowing small quantities of mineral acid at low temperatures to act on mixtures of starch and acetic acid.

200319. Aktiebolaget Separator, of Stockholm. *A centrifugal machine for separating solid and liquid substances, having an inner drum arranged in the main drum and moving relative thereto.* 30th September, 1906. The inner drum in this arrangement has an imperforate casing and engages over the scoop wheels lying on or in the bottom of the outer drum, and supplies to these scoop wheels the solid constituents which are deposited on their inner surface. Fixed

scrapers extending obliquely or spirally and lying in the external drum are also provided and act against the inner side of the inner drum and convey to the bottom of the drum the solid constituents deposited thereon. The external drum is also provided with an insertion, the scrapers inside the inner drum being also arranged on a perforated pipe or a separate drum.

STOCKS OF SUGAR IN EUROPE AT UNEVEN DATES, OCT. 1ST TO 24TH, COMPARED WITH PREVIOUS YEARS.

IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	TOTAL 1908.
145	84	153	93	16	491

	1907.		1906.		1905.		1904.
Totals	623	..	728	..	597	..	775

TWELVE MONTHS' CONSUMPTION OF SUGAR IN EUROPE FOR THREE YEARS, ENDING SEPTEMBER 30TH, IN THOUSANDS OF TONS.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria-Hungary	Holland, Belgium, &c.	Total 1907-08.	Total 1906-07.	Total 1905-06.
1843	1204	663	551	210	4472	4379	4517

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of September, 1907 and 1908.

IMPORTS.

Raw Sugars.	Quantities.		Values.	
	1907. Cwts.	1908. Cwts.	1907. £	1908. £
Germany	5,902,270	5,567,816	2,820,199	2,969,829
Holland	333,998	118,668	168,605	60,690
Belgium	250,746	236,468	112,638	127,213
France	382,945	293,240	197,107	173,853
Austria-Hungary	298,777	453,713	135,043	243,147
Java	552,754	855,281	291,282	418,622
Philippine Islands	187,693	214,588	77,287	88,962
Cuba	91,113	....	39,600	....
Peru	435,125	778,135	215,041	421,092
Brazil	189,899	1,712	78,405	788
Argentine Republic	....	....	....	....
Mauritius	491,210	387,596	200,532	171,433
British East Indies	116,135	158,828	50,517	70,889
Straits Settlements	162,526	99,814	66,735	44,470
Br. W. Indies, Guiana, &c.	1,102,204	718,868	635,258	502,215
Other Countries	505,842	516,720	249,097	287,250
Total Raw Sugars	11,003,237	10,401,447	5,337,346	5,580,453
Refined Sugars.				
Germany	10,176,056	11,062,173	6,020,174	7,107,652
Holland	1,904,811	1,783,081	1,211,726	1,228,412
Belgium	311,050	133,045	190,143	87,312
France	2,817,971	1,410,829	1,652,624	939,329
Other Countries	2,662	338,508	1,844	208,709
Total Refined Sugars	15,212,550	14,727,636	9,076,511	9,571,414
Molasses	2,132,566	2,093,976	421,453	429,893
Total Imports	28,348,353	27,223,059	14,835,310	15,581,760

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	292	673	220	280
Norway	11,011	7,492	6,741	4,954
Denmark	74,443	70,507	40,728	43,261
Holland	50,704	50,217	34,272	35,830
Belgium	7,085	5,887	4,354	4,095
Portugal, Azores, &c.	14,286	16,612	8,026	10,232
Italy	20,107	6,326	10,948	3,851
Other Countries	371,429	230,527	276,331	180,439
	549,357	388,241	381,620	282,942
Foreign & Colonial Sugars				
Refined and Candy	29,267	12,304	19,534	9,687
Unrefined	62,046	340,093	37,015	213,631
Molasses	4,138	2,434	1,247	988
Total Exports	644,808	743,072	439,416	507,248

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1908. Tons.		1907. Tons.
Total Receipts Jan. 1st to Oct. 15th ..	1,691,312	..	1,665,999
Receipts of Refined ,, ,, ...	1,142	..	670
Deliveries ,, ,, ...	1,679,833	..	1,655,872
Importers' Stocks, Oct. 14th	17,099	..	10,127
Total Stocks, October 28th	244,000	..	211,780
Stocks in Cuba, ,, ...	19,000	..	39,000
	1907.		1906.
Total Consumption for twelve months..	2,993,979	..	2,864,013

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1907 AND 1908.

(Tons of 2,240lbs.)	1907. Tons.		1908. Tons.
Exports	1,316,309	..	876,094
Stocks	63,045	..	34,534
	1,379,354	..	910,628
Local Consumption (9 months)	34,980	..	44,040
	1,414,334	..	954,668
Stock on 1st January (old crop)	....	..	9,318
Receipts at Ports up to September 30th ..	1,414,334	..	945,350

Havana, September 30th, 1908. J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR NINE MONTHS, ENDING SEPTEMBER 30TH, 1908.

SUGAR.	Imports. 1906. Tons.	1907. Tons.	1908. Tons.	Exports (Foreign). 1906. Tons.	1907. Tons.	1908. Tons.
Refined	687,543	760,627	736,382	1,496	1,463	615
Raw	580,849	550,162	520,072	7,673	3,102	17,005
Molasses	105,979	106,628	104,699	274	207	122
Total	1,374,371	1,417,417	1,361,153	9,443	4,772	17,742

	Home Consumption. 1906. Tons.	1907. Tons.	1908. Tons.
Refined	663,534	742,602	706,172
Refined (in Bond) in the United Kingdom	414,434	375,778	393,682
Raw	92,979	91,248	87,479
Molasses	97,645	95,691	102,174
Molasses, manufactured (in Bond) in U.K.	44,263	46,069	48,309
Total	1,312,855	1,351,388	1,337,816
Less Exports of British Refined	36,146	27,468	19,412
Total Home Consumption of Sugar	1,276,709	1,323,920	1,318,404

ESTIMATED CROP OF CANE SUGAR IN THE DIFFERENT COUNTRIES FOR THE CURRENT CAMPAIGN COMPARED WITH THE ACTUAL CROP OF THE THREE PREVIOUS CAMPAIGNS.

(Licht's Circular.)

	1908-09. Tons.	1907-08. Tons.	1906-07. Tons.	1905-06. Tons.
Cuba	1,200,000	908,733	1,387,853	1,288,850
Porto Rico	200,000	147,356	212,359	205,272
Trinidad	40,000	37,118	41,280	51,272
Barbados	30,000	30,092	38,100	52,861
Martinique	40,000	38,939	40,443	40,971
Guadeloupe	35,000	35,969	35,348	34,872
British Guiana	110,000	95,606	118,121	123,002
Brazil	210,000	130,000	175,000	210,000
Java	1,050,000	1,222,961	922,904	838,307
Philippine Islands	130,000	129,129	110,688	124,211
Mauritius	190,000	165,322	208,133	188,745
Réunion	35,000	34,065	42,925	26,410
Jamaica	15,000	15,000	18,000	17,000
Lesser Antilles	100,000	80,000	97,000	95,000
United States	800,000	785,000	676,010	624,411
Peru	160,000	140,000	140,000	128,672
Egypt	40,000	40,000	50,000	50,000
Hawaiian Islands	500,000	470,000	440,017	429,213
	4,885,000	4,505,290	4,754,181	4,529,069

ESTIMATED CROP OF BEETROOT SUGAR ON THE CONTINENT OF EUROPE FOR THE CURRENT CAMPAIGN, COMPARED WITH THE ACTUAL CROP OF THE THREE PREVIOUS CAMPAIGNS.

(From Licht's Monthly Circular.)

	1908-1909. Tons.	1907-1908. Tons.	1906-1907. Tons.	1905-1906. Tons.
Germany	2,100,000	2,127,000	2,239,179	2,418,156
Austria	1,350,000	1,425,000	1,343,940	1,509,789
France	850,000	728,000	756,094	1,089,684
Russia	1,300,000	1,410,000	1,440,130	968,500
Belgium	290,000	232,000	282,804	328,770
Holland	190,000	175,000	181,417	207,189
Other Countries	460,000	435,000	467,244	410,255
	6,480,000	6,532,000	6,710,808	6,932,343

THE

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The Editor will be glad to consider any MSS. sent to him for insertion in this Journal and will endeavour to return the same if unsuitable; but he cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named

NOTICE TO READERS.—If the Advertisement pages stick together bang their edges on the table, when they should easily separate.

NOTES AND COMMENTS.

Errors in the Determination of Sugar.

In the May issue of last year we closed our columns, after a lengthy discussion, to a consideration of the question of the influence of the lead precipitate in optical sugar analysis. Messrs. Pellet, it will be remembered, were of the opinion that it was unnecessary to correct for the volume occupied by the precipitated substances, as this source of error was neutralized by the absorption of sugar from the solution by the precipitate at the moment of its formation—a view which was opposed by Messrs. Horne, Deerr, Watts, and Tempany, who advanced experimental evidence against the assertions of Messrs. Pellet, of such a conclusive nature that we considered no good purpose could be served at that time by any further continuance of the discussion.

But in our last number, and in the present issue of this Journal, will be found contributions by Messrs. Prinsen Geerligs and Hugh Bryan, which deal with quite a different phase of the question. These gentlemen discuss the action of lead salts on the impurities contained in commercial sugars. This line of research is an important one, which is now engaging the attention of several well-known chemists. The value of the establishment of a uniform system of sugar analysis must be clear to all concerned in the industry, and we are pleased to publish these papers as a means of furthering this desirable object.

Utilization of Waste Products from the Sugar Cane.

Of late years several devices have been proposed and, to some extent brought into operation, of utilizing more completely the waste products of the sugar cane industry. The first example is the manufacture of molascuit, which now forms an important item in the British import of fodder-stuffs. Especially in countries where the exhausted molasses do not find a use and are generally thrown away, the combination of the two waste products, viz., molasses and the fine particles of megass, into an article fetching a fair price, is a matter of no little importance. The second instance is the manufacture of paper from megass, which has been repeatedly tried, but always without ultimate success. Reports of successful attempts to make such paper have been published from time to time, but in every instance the only product obtained was a coarse, grey or brown wrapping-paper of a rather feeble consistency, so that such paper-making ventures never led to any big development. A couple of years ago a sugar mill in Texas launched on such an experiment, and burnt coal instead of megass, but, according to the *Louisiana Planter*, the attempt was soon after abandoned, owing to the bad quality of the paper.

But more recently (as we briefly mentioned in a previous number) a Trinidad sugar planter, Mr. Bert de Lamarre, has succeeded in producing various grades of paper from a mixture of megass, bamboo and para grass, in which the megass amounts to 65 per cent. We have had the opportunity of examining some of these papers and have submitted them to the investigation of experts, and we are bound to say that though the finish of these samples is hardly as high class as one might have expected, yet the raw material of which they are composed is evidently of the right composition to produce in the hands of an expert paper maker a really satisfactory article. It might in particular serve as basis for a good typewriting paper; and there seems little doubt that the paper makers would be disposed to handle the raw megass pulp if it were offered at satisfactory prices.

It should however not be overlooked that this paper is made not only of megass but contains likewise a good deal of bamboo fibre. Mr. de Lamarre is evidently in the happy position of being able to draw on a large supply of bamboo sufficient to enable him to work up all his megass into pulp. But in countries were bamboo is scarce or expensive, and the factories do not possess a large supply of pure water for washing the pulp, it is hardly likely that such favourable results will be obtained; so that for the present at any rate the manufacture of such paper or paper pulp must necessarily be confined to those factories which possess the particular advantages of the Trinidad estate.

A third device is reported from Java, where attempts are being made to extract cane-wax from filter-press mud. As everybody

knows, the sugar cane is covered with a layer of wax, which is very thin in some varieties but assumes some considerable depth in others. It has often been suggested that the wax should be scraped off from the canes and collected, but this operation is much too tedious and troublesome to become a commercial possibility. The wax, however, passes over into the juice on grinding, and afterwards becomes precipitated in the scums on clarification. Every defecation-scum contains a greater or lesser amount of cane-wax, which may even amount to 10 per cent. in the dried scums, and, of course, much less in the moist ones from the filter presses, which contain, as a rule, no less than 70 per cent. of moisture. A Dutch inventor has induced eight Java sugar factories to try and extract the wax from the dried scums by means of an essential solvent, viz. :—benzine, in a special extraction apparatus.

The benzine is to be distilled off, and the resulting dry wax, which has a green colour, is to be bleached with some chemical agent. Cane wax is a hard substance having a high flash point, and lends itself readily to mixing with paraffin for the manufacture of paraffin candles, because it raises the flash point of the paraffin and, moreover, prevents its crystallization. Up to now the trials in practical working have not yielded the same favourable results as did the preliminary researches made by the inventor; but it is rumoured that a very simple device has been found which will surmount the difficulties experienced so far. The manufacture of wax from the filter-press mud may, therefore, have a good future before it, although the manipulation of huge quantities of such an inflammable substance as benzine in a tropical country, by careless coolies, in the direct vicinity of valuable sugar houses, may cause some feeling of apprehension.

Hawaiian Islands, 1907-08.

The quantity of sugar produced in the Hawaiian Islands for the year ending September 30th, 1908, has amounted to a little over 521,000 short tons; of this amount, 180,000 tons were made in Hawaii, 137,000 tons in Oahu, 123,000 tons in Maui, and 81,000 tons in Kauai. The average yield over the whole area harvested was at the rate of 10,276 lbs. per acre, the irrigated plantations producing at the rate of 12,656 lbs., and the unirrigated plantations at the rate of 7656 lbs. per acre. The amount of sugar produced under irrigation was 336,000 tons, the balance of 185,000 tons, almost all from the island of Hawaii, being obtained under conditions of natural rainfall.

The crop was harvested in forty-eight mills, the average production per mill being over 10,600 tons; the largest amount of sugar produced in any one factory was over 55,000 tons; in addition, three factories made over 30,000 tons, three produced between 20,000 and 30,000 tons, and the output of nine mills was between 10,000 and 20,000 tons.

German Kieselguhr.

The *Journal of the Society of Arts* makes some reference to kieselguhr in a recent number, and explains what it is and how it is procured. Kieselguhr, or infusorial earth, is used in many industries, and has also been tried in the manufacture of sugar. It is found in considerable quantities in Hanover. It is a light, flour-like mass—grey, brownish, or light green—feels soft and dry to the touch, absorbs water, and in ordinary temperature resists chemical action. It is found in layers in alluvial soil, or in the vicinity of lignite deposits. Large quantities exist near Huetzel in the Lüneberger Heide, and also near Unterluess in the same part of Hanover. The kieselguhr extracted at Huetzel is dried only in the open air, and it is generally cleaned before being used. Kieselguhr is also found near Vogelsberg in Hessen, at Jastrabe in Hungary, near Franzensbad in Bohemia, in Tuscany, Sweden, Finland, and also in Canada. The principal characteristics of kieselguhr are the low specific weight it has, which is ·250 to ·550, the high absorption, and its quality of being a very bad conductor of heat, making it one of the most reliable means of protection against the radiation of heat. The method of extraction is similar to that of clay for the manufacture of bricks. The product is removed from the open pit, and then spread upon benches, or hill sides, for the purposes of drying by air or sun. Artificial drying processes—by means of hot air—in rooms, drums, or troughs, have not, it is said by the American Consul at Hamburg, proved practical in Germany. Kieselguhr roasts easily, but must never be brought into contact with a flame, as it would soon calcinate. The drying of kieselguhr in ovens would not be profitable, and such process would never come into consideration in large concerns. Several processes of drying kieselguhr, by using mechanical means, have been tried in Germany during the last twenty years, but have not proved satisfactory, and have therefore all been discarded. K.eselguhr has also been dried by means of hot air and exhausters, but this process is one applied only, in wet weather, in exceptional cases, and with material which has already been dried to a certain extent. This process, however, is not remunerative, and can only be applied with the best quality of kieselguhr—washed for the manufacture of dynamite—and at a time when the market is at high level. It has to be taken into consideration that kieselguhr contains, as it is extracted, 70 to 90 per cent. of water, which evaporates very slowly. Air-dried kieselguhr still contains from 15 to 25 per cent. of water. After having been dried, it is ground, and packed in sacks. During transportation, special care is taken to protect the product against moisture. For crushing mills, there are four different systems in use in Germany.

Death of Sir Henry Bergne.

We regret to have to record the death of Sir Henry Bergne, K.C.B., K.C.M.G., which took place at Berlin on the 15th of November last, while he was acting as British Delegate to the Copyright Conference there assembled. His name has been repeatedly before our readers within the last few years, he having been first British Delegate to the Sugar Bounties Conferences of 1898 and 1901-02, and subsequently Chief British Delegate on the Permanent International Sugar Commission at Brussels. He entered the Foreign Office in 1861, and became successively Superintendent of the Treaty Department in 1881, and head of the Commercial Department and Examiner of Treaties in 1894. In 1886 and 1896 he acted as British Plenipotentiary for the signatures of the Copyright Convention of Bern and the Additional Act of Paris respectively. Amongst other offices he was a Royal Commissioner for the British section of the Paris International Exhibition of 1900. But it was chiefly his work in connection with the Brussels Sugar Convention that has earned him the gratitude of all those who are connected with the sugar industry. Elsewhere will be found a tribute to his memory from the pen of Mr. George Martineau, who, as one of his colleagues at Brussels, had exceptional opportunities of getting to know him and of appreciating the extent and energy of the work he accomplished on behalf of the British sugar industry. To the latter his death will come as a great blow.

Boycott of Austro-Hungarian Sugar in the Levant.

As a consequence of the animosity shown against Austria-Hungary in the Levant and in Turkey because of the annexation of Bosnia and Herzogovina, Austrian goods are being boycotted in the Levantine ports, and among these are the sugars which up to now have found a ready market there. Partly from patriotic motives, and partly from fear of conflict with the population, the dealers are refusing to buy Austrian sugars, and, in consequence, the manufacture of white and sand-sugar has been stopped in many an Austrian factory which usually made this assortment, but is now compelled to make raw sugar for refining purposes.

Meyer & Arbuckle's Patent Film Producer Apparatus.

We are requested to state that in order to give sugar manufacturers and others the benefit of the use of Meyer & Arbuckle's Film Producer Apparatus at a minimum cost, the patentees have decided to allow firms in all countries to provide their own plant until further notice, on consideration that such firms pay the royalty (now much reduced) to the patentees. The sole representative in this country is Mr. F. Meyer, of 17A, South Castle Street, Liverpool; and this gentleman will be glad to furnish all intending users with the necessary particulars and advice on application.

THE AUSTRIAN SUGAR CARTEL.

The startling effect of the Austrian Sugar Cartel of 1899-1900 is still fresh in our memories. This agreement between the various branches of the sugar industry in that country was so complete and so well organized that the margin between raw and refined jumped up at once from an average figure of about 8 crowns (or francs) per 100 kilogrammes to an average of more than 24 crowns during the four years 1899-1903. This extra profit of 16 crowns per 100 k. was divided between the refiners and the producers and at once placed the sugar industry of Austria in such a position as to be able to defy all competition in the export markets of the world and to threaten the natural producers of sugar with certain destruction in a very short time. When Germany followed the example of Austria, with even more striking results, it became clear that those two countries would soon become masters of the situation and would rapidly establish a vast monopoly. A great glut of sugar brought down prices 3/- per cwt. below the natural cost of production, and the German and Austrian sugar industry gaily anticipated the pleasant prospect of destroying all natural competition within the next two or three years. If the Brussels Conference of 1901-2 had not intervened their happy anticipation would have been realised, prices would have risen beyond all previous experience, and the British confectioner, instead of revelling in sugar at 3/- below cost price would have found himself in the iron grasp of a big monopoly.

We know what effect the Convention of 1903 had in remedying this state of things. All the parties to the Convention were compelled to reduce their surtax,—that is, the difference between their excise consumption duty and their customs duty on the importation of foreign sugar—to the comparatively low figure of 6 francs per 100 k. This reduced their protection to such an extent that it was supposed that no profit could be made out of a difference of only 6 francs between the duties on home grown and imported sugar. The British sugar industries were not quite sure that the reduction was sufficient, and stated their doubts pretty clearly. But there was so much anxiety lest the endeavours to obtain a Convention should fail that the figure of 6 francs was accepted.

The effect of the Convention was immediate and complete. The Austrian margin between the cost of the raw sugar and the price of the refined sugar for home consumption, which had been raised by the Cartel from an average figure of about 8 francs to an average figure of more than 24 francs, at once fell to the old figure of about 8 francs.

Since the date of the Convention the industries of Germany and Austria have made several efforts to reestablish a Cartel which might enable them to make some small profit out of the reduced surtax of

6 francs. It was to be simply a refiners' Cartel, because it would be impossible to make a profit sufficient to allow of a division of it between the two industries of production and refining. If such a scheme should succeed it would therefore enable the German and Austrian refiners to compete in British markets, and, in fact, in all outside markets, with an artificial advantage over all their competitors.

In Germany these efforts have, at present, been unsuccessful. But as the scheme has now at last been successfully carried out in Austria there can be little doubt that Germany will soon succeed in following suit, and the British refiners will once more be troubled, on a small scale, with unfair foreign competition.

In one of the excellent and exhaustive accounts which appear periodically in the *Journal des Fabricants de Sucre* M. Dureau gives a full description of the results of the campaign 1907-8 in Austria-Hungary, with tabulated comparative results in former years. With regard to this particular subject he says that after long negotiations the Austrian refiners succeeded, in the beginning of the campaign 1906-7, in establishing an agreement. The effect was soon felt. In that year the margin between raw and refined prices rose to 9·63 crowns (or francs), and in 1907-8 to 12·34 crowns. "In these conditions," he adds, "the industry of sugar refining (in Austria) appears to have become once more very profitable."

If the British Government of 1903 had been still in existence there is no doubt that this would have been one of the main subjects for discussion at recent meetings of the International Sugar Commission at Brussels. But things have changed. The only object at these meetings now is to permit Great Britain to remain a party to the Convention without complying with its terms, and to welcome Russia, where a big bounty prevails, into the Conventional fold.

The new American beet crop (1908-09) is not expected to differ materially in extent from the one just closed. Sixty-three factories will be in operation and 440,000 long tons of sugar is spoken of as the possible output.

A prominent figure in New York sugar circles, and an old subscriber to this Journal, has passed away somewhat unexpectedly in the person of Mr. Hugh Kelly, the leading partner in the firm of Hugh Kelly & Co., of Wall Street. He had been connected with the sugar trade for many years, and was very well informed in all its branches. He was a man of frank, straightforward manner and genial temperament: and his death will prove a loss to the trade no less than to his personal friends.

SIR HENRY BERGNE.

A small Tribute to his Memory.

Those who have had occasion to serve as colleagues with a man occupied throughout his life in the useful service of his country may well have some little shreds of remembrance worth adding to the sad heap of sorrowful memories stored by his more intimate friends and relations. Some of us, I am sure, who have worked with Bergne from time to time have very affectionate recollections of him, not only as a colleague but also as a friend. We got attached to him very quickly, and soon appreciated his keen desire to get at the root of whatever subject he happened to be tackling. Energetic work was always going on around him when matters were urgent. He did not much care about new suggestions when his mind was absorbed in some particular line of action, but if the suggestion was really valuable and important he invariably came round to that conclusion and took it up with energy and skill. He had a peculiar faculty, no doubt acquired from long experience and practice, of putting down on paper in the fewest possible words the pith of the matter in hand, and that faculty of concise and lucid statement became most valuable when he had to state his views at the Conference table. His statement may occupy only a few lines in the published minutes, and the discussion as many pages, but he sat tight and said no more, or as little as possible, and in the end his views prevailed.

I have only space to touch on one other of his many good qualities as a diplomatist. The work of international negotiation by Conference is not all done in the Conference room. There is a good deal of pleasant social intercourse among the delegates from time to time at dinners or receptions. Much good work is done occasionally at such gatherings. On many occasions when matters grew critical Sir Henry Bergne has worked hard all the evening, flitting about from group to group, and in the end securing some useful understanding which might never have been obtained in the Conference chamber.

He was very much in earnest, but always pleasant and gay and hopeful. Difficult technical details he left to others, and when he knew that the work was reliable he accepted the facts put before him without hesitation. Of other kinds of information he was—perhaps unduly—suspicious.

Those who have worked with Sir Henry Bergne feel his loss as a great blank. One consolation must be to look back at the many pleasant times we have spent with him, to remember his unfailing kindness and good-fellowship, and to recall the good work he so ably accomplished.

George Martineau.

ERRORS IN THE POLARIMETRIC DETERMINATION OF SUCROSE, WHEN LEAD SALTS ARE USED AS CLARIFYING AGENTS.

In the ordinary way of preparing a sample of sugar for polarimetric examination, the normal weight is dissolved in about 70 c.c. of water in a 100 c.c. flask, a sufficient quantity of basic lead acetate solution to precipitate the organic impurities added, the contents of the flask made up to bulk, shaken, and finally filtered. It is well known to every sugar-chemist that the use of basic lead acetate solution as a clarifying agent involves certain errors, and that these may, under certain conditions, become considerable. The method, however, on account of the readiness with which it can be carried out is a strongly established one, and although other means of preparing the sample for the polarimetric reading have been proposed (Deerr, this Jl., 1906, 388; Deerr, this Jl., 1907, 127; Wiechmann, this Jl., 1906, 506), its use is unlikely to be soon abandoned in favour of a more tedious and lengthy process.

The sources, extent, and best means of avoiding these errors have given rise to a considerable amount of research by workers of different nationalities, and their investigations may be classified under two headings:—

Firstly, those which are concerned with the volume occupied by the lead precipitate. This question has been discussed to some length in the columns of this Journal, and the reader is referred to a resumé (this Jl., 1906, 10-16) of its literature, and also to articles in this Journal by Pellet, 1906, 17, 455, and 506; 1907, 129 and 204; Deerr, 1907, 13, 122, and 234; Horne, 1906, 336; 1907, 227.

In the second place those which deal with the way in which the reagent may cause error by its effect upon the sucrose and the impurities, especially invert sugar, which are present with it.

Sucrose.—The evidence as to the influence basic lead acetate may have upon the rotatory power of sucrose is conflicting. From the results of early work on the subject it is stated by several authorities, amongst them Weisberg (*Sucr. Belge*, **16**, 407) and Gröger (*Özt.-Ungar. Zeitsch. für Zuckerind.*, **30**, 429) that its action is practically negligible even when used in excess. Svoboda (*Zeitsch. V. d. Zuckerind.*, **46**, 107) and Bates and Blake (*Jl. Amer. Chem. Soc.*, 1907, **29**, 286), however, express a contrary opinion. Working with a very sensitive instrument, these last-named investigators found, after carefully avoiding all possible sources of error, that basic lead acetate decreases the rotatory power if added in small amounts; at a certain point (6 c.c. of a basic lead acetate solution of 1·25 sp. gr. to 100 c.c. of a normal weight solution of sucrose) it has no action; but beyond this the rotation increases in direct proportion to the quantity of the reagent added. Its effect in this respect is attributed to the formation

of a soluble lead saccharate possessing a different rotatory power to that of sucrose. These authors conclude that its influence "is of special signification in the polarimetric determination of sucrose in raw sugars, and is of sufficient magnitude to place it along with the error introduced by the volume of the precipitate, the temperature coefficient, and the presence of invert sugar and other impurities."

Invert sugar. (*a*) *Dextrose.*—Pellet states (*Bull. Assoc. Chim.*, **14**, 28, and 141) that "basic lead acetate and also the neutral acetate are without influence upon the rotatory power of aqueous solutions of dextrose under the ordinary analytical conditions." Reference on this point may also be made to the work of Svoboda (*Zeitsch. V. d. Zuckerind.*, **46**, 107) and that by L. de Bruyn and W. A. van Ekenstein (*ibid.*, **46**, 669).

Dextrose, however, to a certain extent is precipitable by basic lead acetate solution when salts which form insoluble compounds with lead oxide are also present (Prinsen Geerligs, this Jl,, 1908, 435).

(*b*) *Levulose.*—The rotation of levulose is readily modified by the presence of basic lead acetate. This was first pointed out by Gill (*Jl. Chem. Soc.*, 1871, **24**, 91), who stated that "the power of invert sugar to rotate a ray of polarized light is so greatly altered by basic lead acetate that results obtained by the so-called polarization of syrups, &c., containing much invert sugar are worthless when clarification has been effected in the ordinary way. . . . This alteration takes place only on the levulose of the liquid; the dextrose suffers no change. . . . The maximum alteration of the rotatory power caused in this way seems to be equal to that which would be caused by converting all the levulose into an equal weight of dextrose. . . . It is probable a soluble lead compound of levulose of dextrorotatory power is formed. . . . The alteration of the rotatory power of levulose is not permanent, for by removing the lead from the solution, and by acidifying, the original rotatory power of the solution is restored." Bittmann (*Zeitsch., für Rüben-Zuckerind.*, 1880, 1875) and Winter (*ibid.*, 1881, 283) have studied the extent of this influence. The former writer summarizes his results thus:—

Invert sugar solution. c.c.	Water. c.c.	Basic lead acetate solution. Sp. gr. 1·222. c.c.	Polarimetric reading. Degrees V.
50	50	—	— 2·3
50	40	10	— 1·0
50	30	20	3·7
50	10	40	7·6
10	40	—	— 2·2
10	30	10	1·5
10	—	40	6·4
5	5	40	7·6

Whilst acetic acid restores the rotation of a levulose solution thus treated (Gill, *Jl. Chem. Soc.*, 1871, **24**, 92), the levulosate is not formed on the addition of basic lead acetate solution acidified with

acetic acid, nor when neutral lead acetate is used (Edson, *Zeitsch. V. d. Zuckerind.*, **40**, 1037; H. Pellet, *Bull. Assoc. Chim.*, **14**, 141; and Rocques, *Chem., Centr.*, 1900 b, 69).

The levulosate is not precipitated by basic lead acetate solution from a pure levulose solution; but when salts which form insoluble compounds with lead oxide are present, lead levulosate is thrown down. The quantity of the sugar then precipitated is more or less according to the proportion of the salt, the lead acetate, and the levulose present (Prinsen Geerligs, *D. Zuckerind.*, **23**, 1753; and Pellet, *Bull. Assoc. Chim.*, **14**, 141).

Hartmann (this Jl., 1903, 540) has carried out some suggestive experiments investigating the extent of the error due to the precipitation of the levulose in this way. Working with waste molasses he showed that as great an error as that due to the volume of the lead precipitate may be attributed to this cause. The neutral acetate was also used, but the results were almost as unsatisfactory as those obtained with the basic salt. It was found impossible to estimate a constant factor for correction as the composition of the molasses varies considerably with the locality and treatment. He recommended Clerget's method, preferably using the neutral acetate, for the determination of the sucrose in molasses and similar low-grade products—a conclusion which has since been confirmed by H. Pellet (this Jl., 1907, 527).

Mineral and Organic Salts.—The salts contained in raw sugars and juices are capable of affecting the rotation of the sugars either directly (Svoboda, *Zeitsch. V. d. Zuckerind.*, **46**, 108), or indirectly by interacting with the defecant. Sachs (*Zeitsch. für. Rüben Zuckerind.*, 1884, 136) in his well-known experiments on the influence of the lead precipitate attributed a decrease in the rotatory power of sucrose to the alkaline acetates resulting from the interaction between the basic lead acetate and salts of sodium and potassium, and Herles (*ibid.*, 1890, 987) states that this effect can become, in certain circumstances, very appreciable. A further instance of this indirect action of salts is to be found in those which, on reacting with basic lead acetate to form insoluble lead salts, throw down the sugars as lead compounds. Sulphates and chlorides are stated to act most readily in this respect, next citrates, tartrates, &c., and lastly phosphates (Svoboda, *Zeitsch. V. d. Zuckerind.*, **46**, 135).

As showing how dependent the Havana railways are on the success of the sugar crop, the United of Havana's case may be cited. The last year 60 per cent. of the decline in its revenue was due to the falling off in the sugar crop. The stock which 12 months ago stood at 118 has been as low as 56 and there is no dividend available for the ordinary shareholders. The new season's crop, which has an increased area of 49 per cent. is, however, bound to prove remunerative.

VISCOSITY OF CANE SUGAR MOLASSES.

By H. C. Prinsen Geerligs, Amsterdam.

In discussions regarding the output of after-product masse-cuites, especially when a deficient yield of sugar is obtained from them, too great importance is in many cases attached to the viscosity of the molasses, and this property is in most cases represented as something inevitable, and is made responsible for every inferior yield of sugar from the masse-cuite. In many cases too high a quotient of purity of the exhausted molasses is excused or explained away on the assumption that the molasses are so viscous that too high a sucrose content of the exhausted molasses cannot be avoided. The writer does not, however, believe that viscosity is such a special property of juices and syrups that it hampers their desaccharification; but he does believe that inadequate treatment can cause any molasses to become viscous.

It is a well-known fact that the viscosity of pure sucrose solutions increases as the concentration rises and decreases as the temperature rises, and that this latter decrease is stronger than the former increase.

This same thing is also true of molasses, and the table given here shows how even a slight difference in density of the solution of a given molasses at the same concentration causes a considerable difference in the rate of flow of 200 c.c. from an Engler's viscometer.

Cane sugar molasses: Brix, 83·2; polarization, 25·0; reducing sugar, 30·8; ash, 6·13; diluted to

Brix.		Mins.	Secs.
72·62	Rate of flow	22	46
71·15	,, ...	20	44
71·07	,, ...	20	2
70·82	,, ...	19	0
70·72	,, ...	18	35
65·30	,, ...	6	55

Cane sugar molasses: Brix, 80·2; polarization, 31·2; reducing sugar, 26·9; ash, 8·34; diluted to

Brix.		Mins.	Secs.
70·12	Rate of flow	26	44
69·95	,, ...	26	11
69·63	,, ...	25	45

The undiluted molasses was far too stiff to flow out from the viscosimeter, and the experiments were for that reason continued with concentrations of 65-70 per cent. dry substance.

A number of molasses were diluted to about 65 per cent. dry substance, and the rate of flow of those solutions and of sucrose solutions was determined at the temperature of 28° C.

	Brix.	Dry Substance.	Polarization.	Reducing Sugar.	Ash.	Gummy Matter.	Rate of Flow.	
							Mins.	Secs.
Molasses 1	70·3	65·0	23·4	26·9	7·60	1·87	16	30
,, 2	69·9	65·06	26·0	30·9	6·77	1·90	20	20
,, 3	69·9	64·96	25·6	24·4	7·38	0·48	22	25
,, 4	69·0	65·24	27·3	23·5	5·37	1·80	24	11
,, 5	70·7	65·08	20·52	25·5	7·18	1·85	18	35
Sucrose ..	65·0	65·9	65·0	—	—	—	8	57
,, ..	70·3	70·3	70·3	—	—	—	24	10

The result is that for the same dry substance content the viscosity of different molasses does not vary very much, but at any rate is higher than that of sucrose solutions having the same dry substance content. But the non-saccharine bodies of the molasses evidently possess a higher viscosity than sucrose; so in order to ascertain to which constituents this property was chiefly due, the writer determined the rate of flow of a number of substances in solution of 65 per cent. at the temperature of 28° C.

	Mins.	Secs.
Sucrose	8	17
Glucose	6	33
Fructose	4	40
Sucrose and glucose, even parts	7	39
Concentrated "dunder" from a cane sugar molasses distillery	43	10

The substance which accounts for the increased viscosity is therefore one or other of the complex non-saccharine substances, and not the reducing sugar.

The analysis of the concentrated "dunder," or residue left behind in the still after the distillation of fermented cane sugar molasses, was as follows:—

	Per cent.
Dry substance	61·8
Reducing matter	3·9
Ash	15·13
Soluble portion of the ash	3·40
Insoluble portion of the ash	11·73
Carbonic acid in the ash	2·88

It therefore contained some unfermented glucose as well as caramel, decomposition products of sucrose and glucose, and finally salts. Half of these salts were combined to organic and the other half to inorganic acids.

Next 10 per cent. of the different substances were added to a 65 per cent. solution of equal parts of sucrose and glucose, and the viscosity of the mixtures determined at 28° C.

Substances of which 10 % is added to the 65 % sucrose and glucose solution.	Degrees Brix of the solution.	Rate of flow. Mins.	Secs.
Sodium carbonate	76·25	30	23
Sodium chloride	73·9	11	40
Ammonium chloride	65·3	5	0
Calcium chloride	76·8	27	5
Magnesium chloride	67·7	8	27
Barium chloride	77·0	9	26
Potassium oxalate	76·3	11	50
Sodium glucinate *	70·61	16	15
Potassium glucinate *	69·85	10	6
Calcium glucinate *	69·45	22	0
Dry substance from "dunder"	68·45	15	40
Gum	66·9	73	0
Sucrose and glucose	67·8	46	0

We see from this that, just as has been stated by Claassen,† sodium salts increase viscosity more than potassium salts, and calcium salts again more than sodium salts, as is very clearly shown by the organic salts used here.

Except in the case of gum, which properly speaking does not belong to the class of constituents examined here as it is a sticky matter of its own, the sugar is the most viscous of all the substances under consideration. In the case mentioned here where 10 per cent. of different substances was added to a 65 per cent. solution of sucrose and glucose, the rate of flow, and therefore also the viscosity, was greatest when the addition consisted of sucrose and glucose.

This seems strange at first as one knows by experience that pure syrups, in which sucrose is chiefly represented, are much less viscous than impure ones, in which the other constituents are accumulated.

After some consideration, however, this apparent contradiction is explained, when one bears in mind that a pure sucrose solution cannot possess a higher dry substance content than 68 per cent., while impure molasses can contain even 84 per cent. of dry substance and over. The greater viscosity of impure molasses is, therefore, not so much due to their containing certain substances having a high viscosity of their own, but only because of their having a higher density than a saturated sucrose solution can possibly attain.

* These glucinates are the same products of decomposition of invert sugar by alkalies as has been described in this *Journal*, 1908, 284.

† Zeitschrift des Vereins für die Rübenzuckerindustrie, 1893, 535.

As the content of dry dissolved substances greatly influences the viscosity, it is most necessary to examine the viscosity of molasses exclusively in an undiluted state, and a comparison of the viscosity of molasses which are diluted to the same dry substance content can never give any clue to the real viscosity of the undiluted molasses in the practice of sugar manufacture.

The determination of the viscosity of undiluted molasses is a very tedious operation, which is made extraordinarily difficult, if not quite impossible, by the choking up of the tiny discharge pipe of the viscometer from the minute sugar crystals occurring in the thick molasses. The writer, therefore, preferred to leave the molasses alone for practical working, and to have recourse to the same series of artificial molasses, which had rendered him such good service on a previous occasion in his studies on the formation of molasses.*

A number of mixtures were prepared from sucrose, invert sugar, water, and so much potassium acetate and calcium chloride that the amounts of potash and lime were identical, and allowed to crystallize out till all the sucrose which was liable to crystallization had done so; this was controlled by repeated polarizations. Next the just saturated mother-liquors were poured off from the crystals, analysed and tested in an Engler viscometer at 28° C. The figures relate to the rate of flow of 200 c.c. of the thick liquids.

COMPOSITION OF THE MIXTURES.

No.	Sucrose.	Invert Sugar.	Salts.	Water.
I.	600	0	0	150
II.	600	15	0	150
III.	600	60	0	150
IV.	600	120	0	150
V.	600	180	0	150
VI.	600	240	0	150
VII.	600	300	0	150
VIII.	600	360	0	150
IX.	600	420	0	150
X.	600	15	120	150
XI.	600	15	60	150
XII.	600	100	100	150
XIII.	600	100	60	150
XIV.	600	220	100	150
XV.	600	220	60	150
XVI.	600	440	100	150
XVII.	600	440	60	150

*This *Journal*, 1908, 285.

RESULTS FROM THE EXPERIMENTS.

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
Specific gravity at 28°C.	1·3347	1·3413	1·3572	1·3767	1·3771	1·3975	1·4161	1·4244	1·4419
Brix at 17·5°C.....	68·1	69·2	71·7	74·7	74·8	77·9	80·1	81·9	84·3
Dry substance ..	68·1	69·3	72·19	75·15	75·3	78·73	80·87	82·5	85·0
Polarization..	68·1	66·6	56·8	50·2	41·7	41·5	37·6	36·4	35·2
Sucrose	68·1	66·8	57·5	51·6	43·8	43·6	39·8	38·7	37·4
Reducing sugar....	—	2·4	11·0	21·7	29·4	33·3	37·1	37·8	39·2
Ash	—	0·02	0·03	0·03	0·03	0·03	0·03	0·03	0·03
Water	31·9	30·7	27·81	24·85	24·7	21·27	19·13	17·5	15·0
Apparent purity ..	100	96·24	79·22	67·20	55·75	53·28	46·94	46·15	41·75
Real purity	100	96·39	79·65	68·67	58·17	55·38	49·21	44·44	44·0
Brix + water.. ..	100	99·9	99·51	99·55	99·50	99·17	99·23	99·4	99·3
Sucrose on 100 water	314	218	207	208	178	205	208	221	249
Rate of flow	14′ 23″	16′ 30″	36′	1° 19′	1° 21′	4° 2′	10° 6′	22° 11′	118°

	X.	XI.	XII.	XIII.	XIV.	XV.	XVI.	XVII.
Specific gravity at 28°C...	1·4237	1·3785	1·4153	1·4020	1·4523	1·4011	1·4401	1 4355
Brix at 17·5°C.	81·8	74·9	80·5	78·5	85·9	79·6	84·2	83·5
Dry substance	73·07	70·4	74·93	74·0	—*	75·77	79·6	83·17
Polarization	62·5	58·7	53·7	47·0	50·4	45·4	39·4	32·1
Sucrose	62·6	58·8	54·5	47·9	51·7	46·8	41·4	34·4
Reducing sugar	1·92	2·1	11·9	15·2	20·3	21·3	31·5	38·4
Ash	12·42	8·41	8·46	6·75	8·71	5·8	6·45	4·46
Water	26·93	29·6	25·07	26·0	—	24·23	20·4	17·83
Apparent purity	75·17	78·36	66·71	59·88	58·67	57·16	46·79	38·44
Real purity	85·67	83·37	72·73	64·73	—	60·78	52·67	41·36
Brix + water	108·73	104·5	105·57	104·5	—	103·83	104·6	101·33
Sucrose on 100 water ..	236	198	217	184	—	193	203	193
Rate of flow	3° 11′	0° 33′	2° 45′	2° 13′	46° 30′	7° 1′	33° 15′	66° 4′

The viscosity increases with the amount of dry substance, but not in direct proportion with it, as is shown by the table underneath, which detects irregularities in the rise.

* The figure for dry substance was lost during analysis.

Dry Substance.	Rate of Flow.			Dry Substance.	Rate of Flow.	
	Hours.	Mins.	Secs.		Hours.	Mins.
68·1	0	14	23	75·3	1	21
69·3	0	16	30	75·77	7	1
70·4	0	33	0	78·73	4	2
72·19	0	36	0	79·6	33	15
73·07	3	11	0	80·87	10	6
74·0	2	13	0	82·5	22	11
74·93	2	45	0	83·17	66	4
75·15	1	19	0	85·0	118	0

It is a peculiar fact that in the saturated solution the salt-containing liquids have for a given dry substance content a greater viscosity than those which only contain sugars without addition of salts, while in the table for the unsaturated solutions on page 585 it was the solution free from salt that was more viscous than the corresponding one in which the amount of salt was replaced by sugars. It appears that at high concentrations the viscosity of the complex of sugars and salts differs much from that at low concentrations, and this fact is not an isolated one, but can actually be noted on page 586. There it appeared that at a concentration of 65 per cent. dry substance the non-sugar in the molasses was much more viscous than that of a sucrose solution, having that same concentration, whereas when 10 per cent. of dry non-sugar is added to a 65 per cent. sucrose-glucose solution, a much less viscous mixture results than when instead of this non-sugar 10 per cent. of the same mixture of dry sucrose and glucose is dissolved as well. This is another warning against judging the viscosity of the molasses from their behaviour in a diluted state, instead of determining their viscosity in their original, saturated, undiluted, but crystal-free condition.

Where in the case of artificial molasses some regularity was detected in the increase of viscosity together with an increase of dry substance, such a regularity is not so obvious in the case of real molasses under practical working. There we sometimes encounter very high viscosities combined with comparatively small dry-substance contents, and this is due to the presence in the molasses of other bodies than were made use of in the composition of the artificial liquids.

The most prominent among these are gummy substances, decomposition products of reducing sugar, and perhaps also silica. It is a well-known fact that cane-gum and pectin can sometimes occur in exhausted molasses to an extent of 5 or 6 per cent., and it is very evident that such bodies which possess a stickiness of their own can, by their presence, raise the natural viscosity of the molasses to a considerable amount.

Next the decomposition products of reducing sugar separate greasy substances during heating and evaporation, which of course also affect the viscosity of the syrups and molasses. The quantity of silica found in common molasses and not exceeding 0·20-0·30 per cent. is too small to be capable of increasing its viscosity.

With a view to ascertaining the influence of a mixture of gum, so much cane-gum was mixed with a sucrose solution of 66·5 per cent. that its content amounted to 3·86 per cent. on 100 parts of the mixture. Next dry glucose was added to a second portion of that same sucrose solution to such an extent that the dry substance content was equal to that of the gum-containing one. The two liquids then contained the same amount of dry substance, sucrose, ash, &c., but in one case 3·86 per cent. of the glucose was replaced by a similar weight of gum, so that any difference in their viscosity was exclusively due to the gum. Now the rate of flow of the gum-containing molasses was found to be 31 minutes and that of the other 10 minutes 40 seconds, thus showing the great influence of gum on the viscosity. An addition of 0·50 per cent. of dissolved silica had no influence, while that of the addition of a heated calcium glucinate solution could not be ascertained because that substance separated black, greasy flocks, which choked up the discharge pipe and thus prevented the determination of viscosity.

A further cause of increase in viscosity in molasses is due to the presence of small particles of finely divided substance. This was proved by the following experiment in which three portions of similar concentrated sucrose solutions were triturated respectively with 5 per cent. of finely pulverized sugar, 2 per cent. of fine river silt, and 2 per cent. of washed and dried filter-press mud. The rate of flow of the four liquids was as follows:—

	Mins.	Secs.
Sucrose solution without addition	13	10
,, ,, with 5 per cent. pulverized sugar	21	0
,, ,, ,, 2 per cent. river silt	18	35
,, ,, ,, 2 per cent. dried mud	21	0

This shows clearly how a finely divided insoluble substance, such as often occurs in molasses, greatly influences the viscosity and can cause huge differences in that property of molasses of which the mutual proportions of dissolved constituents are pretty well identical.

Apart from these differences, brought along by suspended matter, we are justified in declaring that for the molasses of the same factory the viscosity increases with its dry substance content, and that a molasses, which has been concentrated a few degrees farther than is strictly necessary, has thereby unnecessarily obtained too high a viscosity and consequently requires a correspondingly excessive amount of labour and trouble to get it drained off from the sugar crystals.

One factor has so far remained unconsidered in these investigations, and one that is by no means the least important, viz., temperature. All the determinations of viscosity recorded here are made at 28° C. and relate exclusively to that temperature. As Claassen has showed us, temperature has a great influence on the viscosity, especially between 15° and 40° C. In order to investigate this influence in cane sugar molasses, three molasses, exempt of minute sugar crystals and not showing symptoms of foamy fermentation, were tested for their viscosity at different temperatures with this result :—

	I.				II.				III.	
Dry substance	69·73			..	72·73			..	80·50	
Polarization	35·4			..	28·0			..	22·4	
Gum	5·94			..	1·72			..	1·35	
	Hours.	Mins.	Secs.		Hours.	Mins.	Secs.		Hours.	Mins.
Rate of flow 28° C.	3	50	0	..	3	16	0	..	27	0
„ 35° C.	1	42	0	..	1	47	0	..	19	40
„ 40° C.	0	44	10	..	0	53	10	..	6	43
„ 45° C.	0	29	10	..	0	36	45	..	4	13
„ 50° C.	0	20	0	..	0	25	10	..	2	36
„ 60° C.	0	12	40	..	0	11	40	..	1	30

This shows that the temperature has a great influence on the viscosity, especially at temperatures under 45° C.; above this point a decrease in temperature is not so evidently accompanied by an increase in the rate of flow.

These researches have taught us to consider the concentration and the temperature as the principal factors of the viscosity; and only as secondary ones, the content of gum, the decomposition products of reducing sugar and other deposits, and the presence of fine grains of sugar. It is therefore desirable from a manufacturer's point of view that the molasses be as little viscous as possible in order to enable it to be easily separated from the crystals since it is our aim to obtain as much sugar as we can in a crystallized form and therefore want a thorough separation without much washing in the centrifugals. It must therefore be our endeavour to make the molasses as liquid as is compatible with the keeping of its minimum sugar content. This may be accomplished by taking care not to drive the concentration of the last masse-cuites too far, or, in case they have become too much concentrated, to dilute them with dilute molasses in a judicious manner and this until the sugar-salt combination mentioned in a former paper on molasses* has attained its own full-water content. So to ensure one does not exceed that point, in which case loss would ensue by the dissolving of sugar in the excess of water, the dilution should not be conducted so far as that, but be stopped just before this hygroscopic combination is fully saturated. A water content of last masse-cuites (boiled to grain) after the dilution of 10 per cent. (equivalent to 96° Brix) and a water content of the molasses drained

* This *Journal*, 1908, 290.

off from it of 20 per cent. (equivalent to 85° Brix) are the most favourable ones for the best desaccharification and the lowest viscosity.

The cooling must not be pushed further than 45°C. and should remain preferably a couple of degrees over that figure, as at that temperature crystallization is finished at any rate, and below that the viscosity increases so considerably that cooling down to that point only causes trouble without any compensating advantage.

The increase of viscosity occasioned by secondary circumstances, such as gummy matter, insoluble substances or false sugar grain, can, of course, be avoided by well conducted clarification, subsiding, filtering, boiling, and cooling processes; in short by good work well done. Thus we see that a high viscosity is by no means a property of some particular juice or syrup; but, on the contrary, it is within the power of any sugar maker to keep his molasses fluid and capable of easy separation from the sugar crystals.

EVAPORATOR SCALE.

Mr. S. S. Peck of the Experiment Station Staff, Honolulu, has recently given his attention to the study of the causes leading to the formation of evaporator scale, with a view to suggesting some means by which its occurrence may be considerably lessened. He based his investigations on the results of recent research dealing with the solubilities of various salts in water under different conditions of temperature, time and concentration, whether possessing or not a common ion; and he endeavoured to apply those results in solving the process of scale formation. His own conclusions, as just recently published,* certainly explain some of the phenomena encountered, even if they do not offer any precise solution; and for that reason they should prove of value to other investigators.

It may be remarked at the outset that earlier investigations have not been wanting. Years ago H. Pellet conducted analyses of scales, which are to be found in Deerr's "Sugar and the Sugar Cane." They were chiefly noteworthy as revealing an entire absence of sulphuric acid, and a great increase in silica from first to last bodies.

In Java, Geerligs has devoted considerable attention to the composition of scale, and he has given analyses of comprehensive samples both in his work "On Cane Sugar and the Process of its Manufacture in Java" and (in conjunction with H. Tervooren) in this *Journal*, 1906, p. 39. The same increase in silica is noted in both cases. And in the latter one the effect of defecating the juice with lime is shown in the high content of phosphoric acid in the scale; whereas in cases where the juice had been carbonated there was an almost

* *Evaporator Scale*, by S. S. Peck, H.S.P.A. Div. of Agr. and Chem., Bulletin No. 21, Honolulu, 1908.

entire absence of both phosphoric and sulphuric acids. The conclusions these two Dutch investigators arrived at will be found at length in the article cited and need not be given here. We are chiefly concerned for the present with the investigations carried out in Hawaii during the 1907 season, when 29 samples of scale from 12 mills were secured for analysis. The scales were all scraped from the tubes previous to any treatment by soda or acid; and some of them contained copper in varying amounts, indicating the difficulty which was experienced in removing the incrustations. The deposits were divisible into three classifications, as silicate, sulphate, and phosphate scales. The first two were of a white or light grey colour, the third of a black to dark grey.

Silicate Scales.

As with the scales reported by Pellet and Geerligs, the percentage of silica in Hawaiian scale increased from the third to the last body. These scales, especially when principally aluminum silicate, are hard and smooth, and offer an immense resistance to heat transmission, it having been estimated that they possess a hundred times less conducting power than brass. The silica comes not only from the juice itself, but also frequently from the lime used in clarification. It has been proposed, in order to eliminate the danger of contaminating the juice with this unwelcome substance, to slake the lime, using a considerable amount of water, allow it to settle, and decant and discard the supernatant liquid. Claassen criticises this method, calling attention to the fact that "most varieties of lime contain scarcely any impurities which are soluble in water, and of such only the salts of the alkalies are worth considering, for those constituents of lime which are difficultly soluble in water, or dissolve very slowly, such as, for instance, silicate of lime and alumina, will never be satisfactorily removed, for the simple season that they are much more soluble in sugar solution than they are in pure water."

Experiments conducted to show the solubility of ferric oxide, alumina, and silica contained in quicklime when in hot sugar solution, showed that as soon as the alkalinity was lowered to between 0·15 and 0·07, the percentages of lime and alumina were also less. The solubility of silicic acid, however, remained nearly constant at variable alkalinities. These deposits resist the action of acids, but are partly dissolved by boiling soda solution. Even this sometimes fails to remove it and then mechanical scraping must be resorted to.

Sulphate Scale.

The list of scales contains six which consist principally of sulphate of calcium. The sulphuric acid comes entirely from the juices of the cane, no sulphurous acid being used in the clarification; the extent to which it is present must depend on the character of the soil, the nature of the fertilizers applied, or the property of the cane or of

different varieties of cane in absorbing the sulphuric acid radical from the soil. However, a study of the analyses of soils from the districts represented reveals no marked difference in their respective contents of sulphuric acid. From fertilizers they all receive approximately the same amounts of soluble sulphates; sulphate of ammonia, sulphate of potash, and sulphate of calcium in superphosphates, being always present. The fact that some scales are formed with mineral matter consisting principally of sulphate of calcium may be due to two causes, 1st, that the style of evaporators used, whether submerged tube or film, affects the nature of the incrustation deposited; or, 2nd, that in certain districts, canes, of the same or different variety, have a greater selective power for the sulphuric acid radical than in others; for given the same amount of sulphuric anhydride in the juices as they enter the effects, it would be supposed from the very nature of the changing solubility of calcium sulphate, that the incrustation in the last body would be largely composed of that salt. A certain increase is indeed to be seen; thus, in Mill "F" the percentage of sulphuric acid increases from 1·60 per cent. in the first to 10·34 per cent. in the fourth body, and in Mill "G" from 2·07 per cent. to 6·70 per cent. On the other hand, in Mills "H" and "I" there is no appreciable difference. Two years ago a scale was analysed which came from Mill "B," and also a deposit from molasses from the same source, with results as follows:—

	Scale.	Molasses deposit.
Silica	·17	2·11
Lime	42·87	41·65
Magnesia	·60	·25
Phosphoric Acid	9·48	4·00
Sulphuric Acid	41·76	49·55

It will be seen that the composition of the scale in this instance is practically constant, and is not due to any seasonal accident or peculiarity of the juices.

Sulphate of calcium (anhydrous gypsum) is more soluble in cold water than in hot, and less soluble as the sugar concentrates during boiling and evaporation. The presence of other salts or even of sugar affects the solubility.

A series of experiments was made in the Honolulu Laboratory for the purpose of determining the solubility of calcium sulphate in sugar solutions under conditions approximating those existing during the clarification of juices; also, for comparison, in solutions without sugar and at room temperature. A 13 per cent. sucrose solution was adopted, this being the average of the mixed juices in the local mills, and a solution of potassium chloride containing 2·50 grms. to the litre. The solubility was determined at room and boiling temperature. Two grms. of chemically pure calcium sulphate were placed in 250 c.c. of distilled water free of carbonic oxide, and in solutions of sugar and

potassium chloride, and shaken at frequent intervals during half an hour. Other equal portions were submitted to similar treatment with boiling water. The results showed that the solubility is raised by the presence of potassium chloride and depressed by heat or sucrose under every condition and in nearly the same proportions.

Some analyses of juices for sulphuric acid showed an average in clarified juices of 1·461 grms. per litre. This acid radical is combined principally with potassium and magnesium as sulphates and to a lesser extent with calcium. It has been shown that the latter is less soluble in sulphates of the other two than in water, decreasing with the concentration. But potassium chloride is also present in the juices and the solubility of the calcium sulphate is greater in its solutions than in water. We have here then an explanation of a two-fold action taking place in the evaporators—the tendency of the calcium sulphate to be thrown out of solution, due to the increasing concentration of the sucrose, and the sulphates of potassium and magnesium, counteracted slightly by the increasing solubility of the gypsum in the more concentrated potassium chloride solution. Unfortunately the rate of solution is greatly inferior to that of precipitation, and sulphate deposits or scales result.

A juice clarified in the laboratory with a slight excess of lime contained 0·339 grms. of calcium sulphate per litre. An effect, then, which takes care of 600,000 gallons of juice of a similar composition a week would have 769·95 kgrms. of this substance passing through it. If this juice, originating with 13·48 per cent. sucrose, were evaporated to 55 per cent. sucrose, 118,176 gallons would result, which would, at 158° F., be saturated with 165·07 kgrms. of the lime sulphate, leaving 604·9 kgrms. to be precipitated, either as a deposit from the syrup or after products, or as incrustation on the various tubes, principally on those of the last vessel. If the syrup leaves the last body with 42 per cent. sucrose, 166,184 gallons would accrue, which at the same temperature would contain 538·5 kgrms. of sulphate of calcium, leaving 231·45 kgrms. to be deposited. In other words, the greater the concentration, the larger will be the amount of lime sulphate liable to be deposited as scale; an increase of 8 per cent. in evaporation increasing the amount of scale-forming deposit by 161·3 per cent. Of course, not all of the sulphate of calcium that is rendered insoluble is deposited on the tubes, a large part settling out later in the syrup tanks, and also from the molasses subsequent to blowing up. Of that portion forming scale, a small proportion will be found in the first bodies, but the greater portion in the last, since the tendency to form incrustation will be greatly augmented by the greater viscosity and consequent slower movement of the syrup. The figures given above are no great exaggeration of possible conditions. A scale similar to one of the samples received and a thirty-second of an inch in thickness distributed evenly over the tubes of an effect having

1000 square feet evaporating surface, will weigh 199,735 grms., and with a content of 57 per cent. calcium sulphate will contain 113,849 grms. of that salt; while if of double this thickness, it will weigh twice this amount, or 227,798 grms.

It was noticeable that all the sulphate scales originated in vessels of the submerged tube type: but not all of this type gave sulphate scale, as one mill had a vertical effect.

Removal of Sulphate Scale.

Gypsum can be dissolved by the action of dilute muriatic acid only after long continued boiling, a condition which is not favourable for the long life of the metal containers, although a mixture of the acid with five times its volume of water will not affect copper or brass if it does not consist of more than 50 per cent. zinc. Zinc itself and iron are, however, quickly dissolved.

The best plan is to boil with a dilute solution of sodium carbonate, which has the two-fold action of disintegrating the scale by dissolving the fats and loosening up the other organic matter, and of converting the calcium sulphate into calcium carbonate, which is readily dissolved by weak muriatic acid. Lime sulphate is more soluble in a solution of common salt than in water; and is also soluble in many other salts, such as ammonium sulphate and sodium thiosulphate. But these last compounds have failed to remove incrustations from rum stills.*

Phosphate Scales.

The balance of the scales is composed principally of lime phosphate. The solubility of different phosphates of lime has received extended study from the Hawaiian station authorities. That of tri-calcic phosphate, the insoluble form in which it is precipitated from the juice during defecation, has been greatly complicated by the fact that a true solution of this substance does not take place when it is placed in contact with water, but a partial decomposition results. Its extent varies with the relative masses of the solvent and the solute, the time of contact, temperature, and completeness of agitation. The products of the decomposition are hydroxide of calcium and free phosphoric acid, the latter going entirely into solution, the former partly, the remainder forming with the calcium phosphate left a basic phosphate.

In experiments with a pure preparation of tri-calcic phosphate Warrington showed that after boiling it with water for three hours, the solution contained three times as much phosphoric acid as calcium.

All salts of calcium diminish the amount of phosphoric acid going into solution in water. Solutions of potassium chloride up to a certain concentration act likewise, but increase the amount of lime, the solutions, however, still have an acid reaction. Sucrose solutions

* This *Journal*, December, 1901.

dissolve the phosphate in inverse proportion to the concentration. In order to determine the solubility of the phosphate in such solutions, laboratory experiments were undertaken with solutions similar to those used in the determinations of solubility of calcium sulphate. Four series of tests were undertaken: with water alone, water and potassium chloride, water and sucrose, and water, potassium chloride and sucrose. The solution was determined both with the phosphate alone and with calcium carbonate suspended in the solvent. Calcium carbonate was selected from the list of compounds which decrease the solubility of phosphoric acid as being one possible to use economically and practically if the results warranted it.

In each experiment the determination was made with 500 c.c. of solution, an amount of phosphate equal to 5 grms. of tri-calcic phosphate, and 1 grm. of calcium carbonate. The first test with water alone gave the following results:—

SOLUBILITY OF PHOSPHATE OF CALCIUM IN WATER.

	Temperature	Lime. Grms. per litre.	Phosphoric Acid. Grms. per litre.	Reaction N/10 c.c. per litre.
Without Calcium Carbonate	25° C.	·0053	·0201	3·41 Acid.
	100° C.	·0055	·0777	19·62 Acid.
With Calcium Carbonate	25° C.	·0342	trace	Neutral.
	100° C.	·0077	faint trace	Alkaline.

Boiling rapidly accelerates the decomposition of the calcium phosphate into free phosphoric acid and basic lime, the former increasing over three-fold, while the amount of the latter going into solution remains constant. Addition of calcium carbonate either prevented the solution of the acid, or upon its being released interacted with it forming a fresh precipitate of insoluble calcium phosphate, the amount of phosphoric acid actually in solution not being determinable by ordinary laboratory methods. There was much more lime dissolved when the carbonate was present, but on boiling the amount was reduced to almost that of the solution without this addition.

The solubility of calcium phosphate in water containing 0·25 per cent. potassium chloride was next determined. A decided increase of lime in solution was effected by the presence of potassium chloride, the phosphoric acid remaining unaltered. The relative changes were the same as in the above table.

When the solution containing 13 per cent. of sugar was examined, it was seen that the presence of the sucrose increased the amount of lime going into solution, while that of phosphoric acid was slightly lowered where no calcium carbonate was added. While in pure water solution this compound reduced the amount of phosphoric acid to a mere trace, in a sugar solution it was retained in determinable quantities.

It would appear, then, that under the conditions of these experiments, a boiling solution containing sucrose will dissolve more phosphoric acid than one without.

Phosphoric acid exists in the juices combined with various bases, iron, alumina, lime, magnesia, and potash. On the addition of lime, lime phosphate is precipitated out of solution along with the other insoluble products of defecation, albumenoids, &c. This precipitated phosphate is in contact with the juice for a brief period, as it passes through the heater or is boiled in the defecators, and on being placed in the settling tanks goes to the bottom along with the other eliminated impurities. The conditions of the experiments were consequently quite different, but it was nevertheless hoped that the presence of calcium carbonate in the juice would effect a more complete separation of insoluble lime phosphate, and a correspondingly diminished amount that would enter the evaporating apparatus. In the carbonation process much less phosphoric acid is found in the scale than in that from the defecation process. This is due, according to Prinsen Geerligs, to the fact that in the former case the juices are filtered and particles in suspension eliminated. It may be also due to the fact that such juices are always limed to excess, the alkalinity being reduced afterwards by precipitation of the lime as carbonate by means of carbonic acid gas. There is then so little of phosphates left in the juices, that the increasing concentration in the effects does not cause a precipitation and subsequent deposition of phosphate scale.

EXPERIMENTS WITH JUICES.

With the object of learning the amount of phosphoric acid retained by a juice after clarification determinations were made with a juice having the following composition: Brix., 15·73; sucrose, 12·69; purity, 80·67; glucose, 0·60; glucose ratio, 4·73; phosphoric acid, 1·168 grms. per litre; acidity (terms of N/10 acid), 0·256. Equal quantities of this juice were clarified with varying amounts of milk of lime with a view to having an acid, neutral, and alkaline determination. Duplicates of the acid and neutral clarification were also made with 5 grms. of calcium carbonate added per litre of juice.

The clarified juices showed marked differences in the time necessary for complete subsidence, the alkaline settling slowly, the others more rapidly, and of these, the ones containing the lime carbonate being the quicker. As regards the amount of phosphoric acid removed, there was no gain due to the carbonate, the percentages of removal being:—

	Per cent.
Acid Clarification	49·23
Acid Clarification and Calcium Carbonate	49·40
Neutral Clarification	62·67
Neutral Clarification and Calcium Carbonate..	63·01
Alkaline Clarification	94·43

The lime content of the alkaline juice was a little less than in the others. This has been ascribed to the formation of basic lime salts when juice is limed to excess, whereby calcic salts are thrown out of solution.

But a more complete series of experiments was planned for the purpose of obtaining a juice which was strictly neutral, and in which attention was directed exclusively to the phosphoric acid. A fresh lot of juice of the following composition was procured:—Brix, 16·19; sucrose, 13·18; purity, 81·41; acidity, 0·125. It was decided to substitute a very delicate litmus paper for phenolphthalein as an indicator, and the colour of the juice itself was utilized as a guide to its reaction. Some preliminary experiments were undertaken to establish a colour standard. The colour was observed in a 100 c.c. Nessler jar. The reaction was obtained by preparing mixtures of 20 c.c. juice in 250 c.c. water and adding varying quantities of N/10 soda. It was concluded that 2·5 c.c. brought the juice to neutrality, from which an acidity of 0·125 was deduced; the colour was light green. Next separate portions of 500 c.c. of juice were clarified with varying amounts of powdered quicklime with and without 2 grms. of calcium carbonate, boiling being conducted for two minutes and the juice filtered after settling.

No colour difference was observable between those with and without calcium carbonate, but sedimentation was more rapid with the latter. The reaction was first determined with the delicate litmus paper, and in the subsequent determinations of acidity the juice with 0·525 grms. of lime was accepted as being neutral. The reaction of the others was then determined by the amount of N/10 acid or alkali necessary to bring them to the same depth of colour as this standard.

In the examination of the juices, the analytical data of which are set forth in the accompanying table, a varying but almost regular drop was observed in the purities where calcium carbonate was added. It was not however believed that this was due to any destruction of sucrose, and calcium carbonate is so slightly soluble as not to be able to cause any noticeable change in this respect.

It is apparent that notwithstanding the immense restraining action possessed by calcium carbonate on the solubility of calcium phosphate in water or sugar solution, with and without alkaline chlorides, in the briefer period in which it is necessarily in contact with the juice and its precipitate, its effect is practically nil. It is evident however that the phosphoric acid found in scales is not entirely due to the suspended matter, but also to that which is in actual solution, since the above results are from juices which have passed through filter paper. But that suspended matter does not affect it there is no doubt.

ANALYSES OF JUICES.

Lime. Grms.	Calcium Carbonate. Grams.	Brix.	Suc-rose.	Purity.	Reaction N/10 Solution.	Phos-phoric Acid. Grms. per litre.	Phos-phoric Acid removed. Per cent.
..	..	16·19	13·18	81·41	·125 Acid	1·2122	..
·25	..	17·06	14·06	82·42	·075 ,,	·6672	44·96
·25	2	17·16	14·01	81·64	,, ,,	·6629	45·31
·35	..	16·50	13·58	82·30	·040 ,,	·4282	64·67
·35	2	16·65	13·74	82·52	,, ,,	·4521	62·70
·45	..	16·96		82·61	·0038 ,,	·2229	81·61
·45	2	16·54	13·66	82·59	,, ,,	·1993	83·56
·50	..	16·69	13·90	83·28	·0014 ,,	·1286	89·39
·50	2	16·69	13·88	83·16	,, ,,	·1281	89·43
·525	..	16·75	14·04	83·82	Neutral	·0888	92·67
·525	2	16·75	13·80	82·39	,,	·0888	92·67
·55	..	16·69	14·01	83·94	·0025 Alkaline	·0670	94·47
·55	2	16·69	13·82	82·80	,, ,,	·0674	94·44
·60	..	16·53	13·86	83·85	·0056 ,,	·0531	95·62
·60	2	16·53	13·78	83·36	,, ,,	·0406	96·65

While the results as regards scale prevention are negative, calcium carbonate does have a beneficial effect as regards rate of sedimentation, and will also produce a better press cake, which can be more readily and completely washed. An attempt has been made to utilize this substance in the treatment of syrup in diffusion plants. In a process patented by Dabrowski and Kaczmarkiewiez, the diffusion syrup is treated with natural powdered carbonate of lime, also with milk of lime. The powdered carbonate of lime is obtained from limestone, chalk or pure marl. To the syrup is added, with continual stirring, one per cent. or more of carbonate of lime and sufficient milk of lime to impart to the syrup an alkalinity of 0·07. The syrup is afterwards heated to 80° C., whereby the sediment formed is separated more easily. The removal of this sediment gives a freer boiling syrup. What this sediment is composed of is not stated, but in the light of our present knowledge it is reasonable to suppose that it largely consists of phosphate of calcium, with perhaps some sulphate of calcium which had already separated out from the syrup, but had not been deposited as scale in the effects.

Carbonate of calcium is soluble only to a very small degree in water free from carbonic acid, and less so in solutions of sugar than in water, the degree of solubility lessening with the concentration. It has, as far as known, no deleterious action on sugar; if further

researches should show a method of utilizing it whereby the amount of scale formed can be materially reduced, it will be of immense value in increasing the efficiency of the effects.

Removal of Phosphate Scale.

The removal of phosphate scale by solution in boiling acid presents no great difficulty. A previous treatment with soda is always advisable, in order to disintegrate the organic matter, whereby the time necessary to dissolve the scale afterwards with muriatic acid is lessened. A solution of $\frac{1}{4}$ to 1 per cent. can be used and boiling for an hour will leave the tubes practically free of incrustations.

Methods of Manufacture tending to diminish Scale.

The use of sand filters prevents in a large measure the formation of scale. But the kind of sand used influences to a considerable degree the advantages obtained. At one mill an appreciable reduction of scale was noticed after substituting coral sand for quartz sand. Some experiments carried out with the former variety of sand showed that its action in removing phosphoric acid was very marked, the juice from the sand filter containing less than one-half as much of this element as that not filtered through sand. Where 84·73 per cent. of phosphoric acid was removed by the action of lime alone, 92·91 per cent. was taken out by the action of the lime and sand filter combined.

Where juice settles slowly after clarification, much of the sediment which would otherwise be carried over into the evaporators can be got rid of by using intermediate settlers, which, while not producing as brilliant a juice as sand filters, effect a material reduction in the suspended matter.

Methods of Manufacture tending to increase Scale.

1. It is self-evident that a juice which settles poorly will make scale; in the absence of sand filters or intermediate settlers, clarification must be improved to avoid this. A very obstinate juice can be made to settle by the well-known method of over-liming and the addition of "clariphos" or a similar phosphoric acid combination, the heavy precipitate of calcium phosphate settling rapidly and carrying down with it most of the suspended matter. Care must be taken that the juice is left neutral or slightly alkaline, otherwise the object aimed at will be missed.

2. It is obvious that returning remelted low grade sugars into the evaporators without previous clarification must introduce many impurities into the effects which would be avoided if the remelts had first been sent through the clarification process with the mill juice. The objection has been urged against this that an increased sucrose content in the press cake is produced, or a greater volume of water used in the washing thereof made necessary; but if the remelt is

allowed to mix slowly and continuously with the mill juice, this need not be feared.

3. Mixing press juice with the clarified juice just before it enters the effects is very liable to produce an immense amount of scale, particularly in the first body. Usually the scums are given additional lime and boiled up, before they are pumped into the filter presses, so that the press juice is of a greater alkalinity than the juices from which they originated. Any juice, unless limed to a considerable alkalinity, will give a further precipitation when more lime is added; so that upon the admixture of the over-limed press juice with the neutral or under-limed clarified juice, a fresh precipitate is formed. Without any opportunity for depositing, this precipitate enters directly into the first vessel, with disastrous results to it as regards scale. It would seem that in such cases all difficulty might be avoided by a more heavy liming of the juice for clarification. With many juices, however, it has been found necessary, in order to produce good settling or good boiling qualities, to keep them neutral, or even slightly acid. It is much better to run the press juice, whether it has been used for remelting low grade sugars or not, into the mill juice for re-clarification, or rather for re-settling.

THE PRECIPITATION OF REDUCING SUGARS WITH BASIC LEAD ACETATE.*

By A. Hugh Bryan,

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The recent remarks by Mr. Prinsen Geerligs in the September number of the *International Sugar Journal* upon the precipitation of levulose by basic lead acetate are well timed and I most fully concur in what he says against clarification with alkaline lead salts when determinations are to be made of reducing sugars. The experience of Mr. Geerligs coincides fully with my own, and I believe that if Messrs. Watts and Tempany (Abstracts, Scientific and Technical, this *Journal*, 1908, 200-201,) will repeat their experiments, using with their invert sugar solution some organic or inorganic compound that will form a precipitate with the basic lead acetate, they will find a very marked precipitation not only of levulose, but of dextrose and all other reducing sugars.

The question is not new. Pellet has shown in numerous articles that basic lead acetate precipitates levulose to a large extent, and should not be used as a clarifying agent when reducing sugars are to be determined. Wiechmann (this *Journal*, 1906, 603), has also shown

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that levulose, in the presence of certain salts is precipitated by basic lead acetate.

As referee upon sugar for the Association of Official Agricultural Chemists, at the 1906 meeting (*Bur. of Chem. Bulletin*, 105, p. 120), Dr. C. A. Browne called particular attention to the fact that with the addition of an excess of basic lead acetate, the percentage of reducing sugars or the copper reducing power of all solutions was lowered. The average results for reducing sugar determinations of three collaborators on the same sample of molasses, sugar, and massecuite, with no clarification, and when clarified with the addition of 1-2 c.c. basic lead acetate, also with an excess of the same precipitant gave :—

PER CENT. REDUCING SUGARS AS DEXTROSE.

Clarification.	Molasses. Per cent.	Massecuite. Per cent.	Sugar. Per cent.
No clarification	31·89	26·92	7·39
1-2 c.c. basic lead acetate.. ..	31·39	26·25	7·08
Excess of basic lead acetate ..	28·68	24·24	7·03

It is seen that with an excess of basic lead acetate in the molasses and massecuite samples, the reducing power of the solution has been lowered fully 10 per cent., and with the sugar sample nearly 5 per cent. That this is not due to the removal of reducing bodies, which are non-sugars, is shown by the fact that there is likewise a decrease in the yield of alcohol when such clarified solutions are subjected to fermentation.

In 1907 (*Bur. of Chem. Bulletin*, 116, p. 68-76), the study of the precipitation of reducing sugars by basic lead acetate, both wet and dry, was again taken up. The average results of collaborators for that year show :—

PER CENT. REDUCING SUGARS AS DEXTROSE.

Clarification.	Sugar. Per cent.	Molasses. Per cent.
No clarification	6·82	20·11
Lead sub-acetate	6·43	18·49
Dry lead sub-acetate	6·36	18·47

In the case of the sugar sample, there has been a reduction of over 6 per cent., and with the molasses of over 8 per cent. in the copper reducing power of the solutions by the clarification with a solution of basic lead acetate. The dry sub-acetate of lead, Horne's method (*Jl. Amer. Chem. Soc.*, 1904, **26**, 186) has the same precipitating power as the sub-acetate solution.

In order to determine just what effect the different precipitants have on reducing sugars, I prepared solutions of dextrose and levulose, using 5 grms. of sugar and 1 grm. each of magnesium sulphate and ammonium tartrate. To 50 c.c. of this solution the precipitant was added and the volume made up to 100 c.c. After filtering, the excess of lead was removed with potassium oxalate and the sugar determined by Allihn's method.

Precipitating Agent.	Amount per 100 c.c. of solution.	Dextrose removed. Per cent.	Levulose removed. Per cent.
Normal lead acetate solution..	3·5 c.c. ..	0·93 ..	0·00
,, ,, ..	7·0 c.c. ..	0·84 ..	0·00
Lead sub-acetate solution	3·5 c.c. ..	3·35 ..	8·03
,, ,, ..	7·0 c.c. ..	8·34 ..	19·91
Dry lead sub-acetate	1·0 grm...	3·85 ..	14·93
,, ,, ..	2·5 grm...	17·48 ..	35·33
Basic lead nitrate, Herle's solution, (*Zeit. Zuckerind. Böhm.*, **21**, 189)	4·0 c.c. ...	6·27 ..	13·84
,, ,, ...	8·0 c.c. ..	5·61 ..	25·12

The normal acetate of lead removed practically no reducing sugar in any of the experiments; the lead sub-acetate, on the other hand, whether in solution or dry, and the basic lead nitrate solution removed very large quantities of both dextrose and levulose, the latter sugar always in much larger amounts. In the old methods of the Association of Official Chemists (*Bulletin 46*, *Revised*, *Bureau of Chemistry*), the sub-acetate of lead was always prescribed for clarification before determining reducing sugars. In view of the manifest error involved, the use of this reagent was discontinued by the Association, and at the present time only the normal lead acetate solution is used (*Bulletin 107*, *Revised*, *Bureau of Chemistry*).

The effect of different lead salts upon the polarization of mixed solutions of sucrose, dextrose, and levulose in the presence of optically inactive compounds precipitable by lead salts was also studied. In the case of one such mixture made up in the proportions of a low grade sugar, with 0·5 grm. ammonium oxalate and 0·5 grm. sodium sulphate to 100 c.c. of solution, the following results were obtained:—

No.	Amount of Clarifying Agent.	Clarifying Agent.	Direct Polarization. Per cent.
1	5 c.c.	Alumina cream	89·00
2	3·5 ,, ...	Lead sub-acetate solution	89·50
3	7 ,, ...	,, ,, ...	89·55
4	3 ,, ...	Normal lead acetate solution	89·20
5	6 ,, ...	,, ,, ..	89·20
6	1·5 grm.	Dry lead sub-acetate	89·05
7	4 c.c.	Basic lead nitrate solution	89·00

Taking the experiment with alumina cream as the true polarization it is seen that the lead sub-acetate solution gives a reading of 0·5 per cent. too high, and the normal acetate 0·2 per cent. too high. The excess reading in the latter experiment is due to volume of precipitate, and in the former to both volume of precipitate and precipitation of levulose. The dry lead and basic lead nitrate give readings in this particular experiment exactly identical with the true polarization. This might seem at first sight to indicate no precipitation of optically active bodies; such a precipitation does take

place, however, as was previously seen, and the experiment only shows that in these two instances the dextrose and levulose were precipitated in the proportions necessary to produce optical neutrality.

For further particulars upon this subject, reference is made to the reports of the Referee on Sugar in 1906 and 1907, *Proceedings of the Association of Official Agricultural Chemists*, published in Bulletins 105 and 116 of the Bureau of Chemistry, Department of Agriculture, Washington, D.C. The ideal clarifying agent for polariscopic purposes—one that will clarify without precipitating or affecting in any way the optical components of the sugar or changing the volume of the solution—still remains to be discovered.

THE ARGENTINE SUGAR INDUSTRIES.

The greater part of the sugar consumed in the Argentine Republic is produced in the province of Tucuman, the capital of which bears the name of San Miguel de Tucuman (shortly Tucuman), lying about 1400 feet above sea level, possessing a delightful climate, and a population of over 50,000, and distant about 780 miles by rail from Buenos Ayres. The city lies about 150 miles due east from the well-known mountain peak of Aconquija, and 70 from the main chain of the Cordillera, which rises very abruptly from the plains and low foot hills to an elevation of 15,000 to 17,000 feet. The climate may be classed as sub-tropical, with an annual rainfall of about 40 inches, and is very healthy, although there are frequent alternations during the day, as, for instance, the temperature will be up to 104° shade at noon and fall to 56° by 7 p.m. In the winter, the temperature falls occasionally to something below 32° Fahrenheit, though in the extreme northern part of the province both the temperature and the rainfall is greater, a circumstance which enables the cane grown there to yield better results, both in weight and sugar content. The cane produced in the larger portion of the province, however, is very hard, short, and poor, giving an average yield, even after heavy crushing, of about 11 per cent. only on the weight of cane, an average of 1 per cent. better than the cane grown in Spain. This is owing to the low temperature, which at night occasionally falls to freezing point, turning the leaves brown. Irrigation is occasionally resorted to, but with less effect upon the yield which it would have in a warmer climate. Indeed, the wonder is that sugar is produced at all, and it certainly would not be grown but for the high protective duties.

The land runs down from the foot of the great mountain wall of the Cordillera in a very gentle slope for hundreds of miles, and the soil is very deep (sometimes as much as 40 feet), a rich loam with hardly a pebble in it; and although ploughs are extensively used in the cultivation, the ground is too soft to permit the use of steam engines and

heavy cultivators. Experiments, however, are now being carried on with a light tractor for hauling the ploughs, but it is not yet ascertained whether it will turn out to be of practical value. Building stone is very rare and expensive, and the bricks made in the district are of very inferior quality. Even in Buenos Ayres it was necessary in building the warehouses for the docks to import bricks from England.

The canes are planted annually, as the planter does not care to risk the chance of losing the crop by a winter frost; and as the cane is only about ten months in the ground it is naturally poor, and the yield is light. The whole trade is an artificial one, and would not exist six months if the high protective duties on the article were repealed. The climate also is not well adapted for sugar growing, and the cost of production is far too great to compete in the open market with tropically grown sugar, say from Java, Mauritius, or the West Indies, which could be put down at Buenos Ayres at a good profit if it were not for the high tariff which may be said to consider the interests of the producer only, totally disregarding those of the consumer.

As it is, the Tucuman sugar costs about £18 per ton to produce even with the aid of large modern factories possessing the best labour-saving appliances, *e.g.*, cane can be loaded on to the carrier by a specially constructed crane at the rate of fifty tons an hour with only three men at work. The factories are large and possess machinery of great power with up-to-date appliances, and some can crush 1400 tons of cane in the 24 hours and turn out 10,000 tons per annum.

Labour, however, is bad, scarce and dear, *e.g.*, an average field labourer will receive about £4 sterling per month. All nations are to be found in the labour market. The workmen are very independent, and a factory will often have to stand still while the men are enjoying one of the holidays unfortunately only too numerous in Argentina.

The out-turn for the present year has been unusually good and the planters having money to spend have been sending over a good many orders for machinery for the next season.

Our correspondents in the country advise us that with all the drawbacks above enumerated Argentine sugar culture is well worth studying; some further and more detailed accounts will, therefore, probably appear in a subsequent number of this Journal.

It is announced that Professor Blouin has left the Sugar Experiment Station, Audubon Park, New Orleans, where he has been Director for some years, and has gone to Tucuman, Argentina, having accepted the offer of the Argentine Government to take charge of a Sugar Experiment Station in the Tucuman district. His departure will prove a loss to Louisiana sugar circles, but Argentina should be a gainer by the new appointment.

QUEENSLAND.

The Sugar Experiment Stations, 1907.

Dr. Maxwell's report on the Sugar Experiment Stations under his charge for 1907 contains some further account of experiments conducted on certain varieties of canes which had been originally introduced from foreign countries and up to the beginning of the year under review had successfully passed through the plant, first ratoon and second ratoon crops. Twelve of these, all of which were New Guinea varieties, were considered fit for third ratooning. Their cultivation consisted of ploughing and subsoiling between the rows; afterwards, until the cane was well up, they received light cultivation with a broad hoe cultivator. Mixed fertilizers were applied to all the varieties. Immediately after ratooning good rains set in and continued till the end of the year, during which time the crop made a remarkably fine growth. Progressive analyses of the varieties were carried out up to the time of cutting. The results of the experiments showed that five of the varieties were still maintaining their lead as sugar producers. Their record for the four years 1903 to 1907 is given as follows:—

Name of Variety.	Total cane per acre. (Four crops.) Tons.	Total sugar per acre. (Four crops.) Lbs.	Total sugar per acre. (Four crops.) Tons.
New Guinea, 8A	182·9	68,808	30·7
,, ,, 15	198·2	81,818	36·5
,, ,, 24	202·3	76,430	34·1
,, ,, 24A	187·9	71,415	31·8
,, ,, 24B	184·1	67,101	29·9

The description of these canes is given in the report, as follows:—

New Guinea 8A (New Guinea name, Gogari).—A dull, deep green cane of moderately stout habit, turning a reddish colour on exposure. Internodes usually 4 to 6 inches long, and occasionally grooved. Habit lodging. Trashes easily. Flesh yellow. A sparse arrower at station. Spring planting appears to suit this variety best.

New Guinea 15 (New Guinea name, Badila).—A dark purple to black coloured cane. Stout sticks, with pronounced white waxy rings at nodes. Internodes usually 2 to 3 inches long, but sometimes longer, especially in ratoon cane. Habit erect; foliage also somewhat erect and very green. Eyes generally full and prominent. Trashes easily. Has never arrowed at station. The foliage of very young cane has a slightly reddish tinge. Flesh white and highly saccharine. A remarkably heavy cane, often weighing 1 lb. per foot. Greatly appreciated by labourers, as it is so easily cut, trashed, and loaded.

New Guinea 24 (New Guinea name, Goru or Goru possi possana).—A greenish brown to copper-coloured cane, moderately stout. Joints have a pronounced zigzag appearance. Internodes usually from 3 to 4 inches long. This cane has a slight waxy bloom. Habit: inclined to lodge. Basal end

develops roots, and upper eyes sometimes shoot. Foliage broad and plentiful. Trashes readily. Flesh yellow. A sparse arrower at station.

New Guinea 24A (New Guinea name, Goru Scela Scelana).—Like No. 24 (Goru) in appearance and colour, but is distinctly marked with longitudinal reddish-coloured stripes. Moderately stout. Internodes 3 to 4 inches long. Habit, lodging. Foliage broad and plentiful. Trashes easily. Flesh yellow. Has never arrowed at station.

New Guinea No. 24B (New Guinea name, Goru Bunu Bunana).—This cane also resembles No. 24 (Goru) in shape, though not in colour, which varies from yellow to yellowish green. On exposure, the skin of this cane is sometimes marked with reddish granular spots. Internodes usually 3 to 4 inches long. Eyes full and prominent. Foliage broad and plentiful. Trashes readily. Flesh yellow. A very sparse arrower at station. New Guinea 24B is more upright in growth than either 24 or 24A, and is somewhat thicker. It is a nice clean cane to handle, and should be a favourite with cutters.

Dr. Maxwell has frequently pointed out to farmers that continued ratooning over the second or third ratoon crops is, agriculturally speaking, bad practice; but the question of labour being at this time such a crucial and determining factor, he has decided to continue for another crop at least the ratooning of those varieties which still show a complete immunity from disease. "The final question is not how to get the biggest crop, but the getting of a crop that pays the biggest, and possibly the only kind of crop which the farmer, under present labour conditions, is able to get at all." Dr. Maxwell considers that "high experimentation and the best modern methods that are practised in other cane-growing countries are gradually becoming impossible in Queensland, due to the want of labour power, at a paying cost, to carry such methods into practice."

Other experiments which were continued by the Experiment Station staff were concerned with the comparison and determination of the final commercial value of the ten leading varieties that have been brought into competition. The series were carried out in quadruplicate and were intended to exhibit the producing values of the varieties under four sets of conditions involving irrigation or no irrigation, mixed manures or none at all. The plants were all first ratoons.

The following table presents the average results obtained from the plats under the four sets of conditions. It is shown that the irrigated plats with manures gave a slightly lower result than the corresponding non-irrigated plats with manures; while the irrigated plats with no manures gave a slightly higher result than the corresponding non-irrigated plats with no manures. The irrigated plats with manures show an increase of 9·3 tons of cane per acre, and 1·3 tons of sugar over the irrigated plats with no manures; and the non-irrigated plats with manures show an increase of 10·7 tons of cane and 1·2 tons of sugar per acre over the non-irrigated plats with no manures:—

Average of Results from the First Ratoons of the Ten Best Varieties under Four Sets of Conditions.

Conditions.	Weight of Cane per Acre in English Tons.	Yield of Sugar per Acre in Pounds.	Yield of Sugar per Acre in English Tons.
Irrigated plats: mixed manures; other conditions of cultivation being equal	41·9	15,327	6·8
Irrigated plats: no manures; other conditions of cultivation being equal	32·6	12,284	5·4
Non-irrigated plats: mixed manures; other conditions of cultivation being equal	42·4	15,028	6·7
Non-irrigated plats: no manures; other conditions of cultivation being equal	31·7	12,285	5·4

The varieties tested consisted of seven New Guinea canes, two Mauritius, and one Trinidad seedling (No. 60). As far as the experiments have gone, the New Guinea canes No. 24 and No. 15 have been maintaining a lead both in cane and sugar production over their rivals from Mauritius and Trinidad.

Some simultaneous experiments were undertaken to determine the most advisable distances between the plants in the row and the distance between the rows, or the number of eyes, plants, and weight of seed per acre. A piece of land was set apart in 1905 for a series of planting tests, and the report of that year gave some particulars of preliminary results. In 1907 further tests were made on first ratoon cane, and as far as can be judged at the present stage of the experiments, they tend decidedly to confirm the view already held that: firstly, one plant with three eyes, with six inches between the plants in the row, is the best way of planting the seed in the row; secondly, that any increase in the distance between the rows exceeding five feet is likely to result in a lower weight of cane and yield of sugar per acre, while less than five feet between the rows can result in an increase of cane and sugar per acre. Of course the different nature of soils and climatics has a decided bearing on these questions.

Several new varieties have been introduced since last year, including the well-known B 147 and the Mauritius Malagache.

A number of the most promising varieties of cane already referred to have been distributed from the Mackay station to sugar growers all over Queensland for experimenting with, and the reports sent in to the Experiment station have fully justified the venture. These reports show that certain varieties are giving the best results in the climatic conditions of the north and in the northern soils, while other varieties are apparently less suited for those conditions but are doing well and promising good commercial results in the more temperate climatic conditions of the south and in southern soils.

A number of varieties of cane, which originally possessed a high-class record, have of late years become affected with disease and debility; they were accordingly planted out on a virgin piece of ground, subsequently called the Station Hospital. They included the White Bamboo, Striped Singapore, Rose Bamboo, Louisiana Striped, Louisiana Tiboo Merd, D 74, D 95, T 202, and several others.

The object of this isolation was to give the variety a chance of recovering and of becoming an absolutely healthy organism again. Twelve months ago the *modus operandi* was summed up as follows :—"For the time being the debilitated varieties are being placed under the conditions that are considered the most favourable for enabling them to resist the progressive action of disease and to afford them the means of an ultimate recovery. Should any of these varieties during their period of three crops throw off every appearance of debility, or specific disease, they will be restored to the class of sound and valuable cropping varieties. Otherwise they will be abandoned."

Since then they have had a year's period of growth as a plant crop. As the canes progressed towards maturity, examinations of diseased stalks, and also of apparently healthy ones, were made for the purpose of ascertaining if gum or other disease was indicated. Sections of these stalks were also cut and examined microscopically. No symptoms of root or fungoid disease were discovered, but the gumming disease was apparent in several varieties.

Acidity determinations were made on all the samples, but these did not tend to confirm Dr. Erwin Smith's opinion (quoted in last year's report) that the immunity of certain canes from the gumming disease is probably due to their high acidity, for although the average of acidity was slightly higher in the canes apparently unaffected, yet some individual varieties in which the disease was seen have given a higher acidity test than those in which it was not observed. The acidity in canes growing upon other portions of the station cannot be compared with the acidity in the hospital canes, for the reason that the former are ratoons growing upon old limed land, while the latter are plant, growing upon virgin soil.

The following table embodies the general observations made upon the foliage and appearance of some of the principal canes, the examination of the sticks for gumming or other diseases, and the number of apparently sound and diseased sticks at the time of cutting. Although the varieties, as a whole, appeared to have recovered somewhat, and fewer sticks seemed affected by the gumming disease, yet, before any definite conclusions can be drawn, the results of the ratoon crops must be awaited, when it is hoped some of the varieties will be found to have recovered totally from tendencies to given diseases :—

No. or Name of Variety.	General appearance of Foliage and Cane.	Result of Examination of Individual Canes by Cutting Sections.	Number of Apparently Healthy Canes per Acre.	Number of Apparently Diseased Canes per Acre.
White Bamboo	Short stunted cane, very few living plants	Gumming disease indicated	Nil	5,450
Striped Singapore ..	Very poor	Gumming disease indicated	6,812	1,090
Rose Bamboo..	Foliage rusty.. ..	No gum visible ..	21,800	2,452
Louisiana Striped ..	,, ,, ...	Gumming disease indicated	15,532	2,997
,, Tiboo Merd	,, ,, ...	Pithy centres; no gum seen	19,075	5,450
D. 74	Tops all dead; every cane arrowed; early maturity	Pithy centres; no gum seen	32,700	Nil
D. 95	Poor; tops dying ..	Gumming disease indicated	13,625	1,635
Trinidad S. 202.. ..	Tops all dead.. ..	Pithy centres; no gum seen	24,525	Nil
New Guinea 3	Poor; foliage rusty	Gumming disease indicated	10,900	817
,, ,, 7 ..	Fair; ,, ,,	Gumming disease indicated	27,000	250

CONSULAR REPORTS.

Madeira.

The 1907 cane crop was the largest that has ever been produced in Madeira, the quantity being estimated at 45,000 tons with a value of £170,000 as against the 1906 crop of 33,000 tons with a value of £125,000. About 21,000 tons were converted into sugar, the remainder being utilized for alcohol and cane-brandy. About 720 tons of sugar were exported to Portugal and the balance consumed locally.

The "Yuba" cane, which was introduced five or six years ago from Natal, continues to form by far the largest proportion of the production, while the old species diminishes in quantity year by year.

Further improvements were made in the Hinton-Naudet process by which a still greater reduction was effected in the percentage of saccharine matter left in cane refuse, and this reduction has been maintained and even improved upon in the 1908 system, which has just commenced at the time of writing this report.

Since last season the sugar factory (which is British owned) has doubled its producing capacity, and magnificent new mills have been laid down.

The commercial report on Madeira for 1906 contains details of the special law under which the sugar factory conducted its operations, and of the difficulties encountered. These have by no means been overcome. It was only after months of hard work and heavy financial loss that the owners of the mill succeeded in getting the Portuguese Government to allow Madeira cane sugar free entry into Portugal, and even now the custom-house have demanded a bond for the payment of any sum which subsequently may be legally considered due by the Government in respect of any sugar sent to Portugal.

Surinam.

Owing to the unfavourable season the 1907 crop was somewhat less than that of the previous year:—

Total—	
1906	12,635 tons.
1907	11,930 ,,
Rum	189,035 gallons.
Molasses	61,780 ,,

Norway.

The imports of sugar in 1907 showed a considerable increase over 1906. They were—

	Tons.	£
1906	36,452	449,328
1907	39,417	658,205

More than four-fifths of the sugar came from Germany.

Syrup shows an increase in weight of 311 tons, whereas the value shows a decrease of £5678. The importation from British ports shows a considerable increase from 1905. While the United Kingdom in 1905 scarcely contributed one-third of the total importation, the same increased in 1906 to 5478 tons out of a total of 13,637 tons, the remainder coming principally from Denmark.

Austria-Hungary.

The British Consul-General reports as follows:—

Sugar deserves special mention, as this article forms the most important of all the Austrian exports; the figures in tons for the last three years were:—

	Raw. Tons.	Refined. Tons.
1905	89,000	481,000
1906	55,000	704,000
1907	110,000	587,000

The chief countries to which refined sugar is sent from Austria-Hungary are:—

	1906. Tons.	1907. Tons.
United Kingdom (*viâ* Hamburg)	333,000	207,000
Turkey and Greece (*viâ* Trieste)	187,000	127,000
East India (*viâ* Trieste and Fiume)	117,000	66,000
Switzerland	44,000	49,000

The total export of raw sugar increased from 55,000 tons in 1906 to 110,000 tons in 1907, the increased quantity going entirely to the United Kingdom. This increase in the import of Austrian raw sugar by the United Kingdom is regarded here as due to the increased activity of the British refineries brought about by the Brussels Convention.

Some fears are expressed as to the future competition of Russian sugar on the British market, now that Russia has joined the Brussels Convention. It is thought that Russia may prove to be a more dangerous competitor to Austria than the cane sugar producing countries, which have not managed to displace beetroot sugar in the United Kingdom in spite of the assistance given to them by the abolition of the bounties.

The decrease in the export to India is attributed partly to the good crop of Indian cane sugar and partly to the competition of Java and Mauritius in the Indian sugar market, to which these countries have turned their attention since their export to the United States of America has been rendered difficult by the preferential duties given to the sugar growers in Cuba, Porto Rico, the Hawaiian Islands, and the Philippines.

The export to Turkey has fallen off, owing to a bad harvest which diminished the purchasing power of the population in several provinces.

Besides these external circumstances there are two internal matters of importance in connection with the Austrian sugar industry in 1907 which must be mentioned.

The first concerns the beetroot crop. The high prices of cereals ruling in Austria, partly caused by the increased duties under the new tariff, have made corn growing more profitable than of recent years. The farmers, particularly in Bohemia, who were discontented with the arrangements made by the Sugar Trust for buying the beetroot, took advantage of this fact to press the sugar manufacturers for higher prices just before the time for sowing, and threatened to give up growing the crop unless their wishes were met.

Ultimately most of the growers agreed to accept an increase in the price of about 1d. per cwt., and the area devoted to the sugar beet last year only fell off by 1·8 per cent.

The other matter is the proposal to reduce the very high Austrian (not Hungarian) excise duty on sugar of 38 kr. per 100 kilos. (about 15s. 10d. per cwt.) by 8 kr. (6s. 8d.).

The effect of this would be to increase the internal consumption of sugar, and the manufacturers believe that it would as a further consequence help them in dealing with the export trade.

The Lower House of the Austrian Parliament is in favour of the reduction, but has insisted on inserting certain provisions in the Bill

imposing penalties on the sugar manufacturers if they do not reduce the price of sugar by the full amount of the reduction in the duty. The Upper House is against these provisions and the disagreement between the two branches of the legislature is likely to render the early passing of the measure rather doubtful, particularly as the Minister of Finance is opposed to the reduction of the duty on the ground of the anticipated loss of revenue.

The Azores.

In 1906 the value of the sugar imported from all countries was £5383, the principal amounts being £2211 from Germany, £1794 from the United States, and £922 from the United Kingdom. In 1907 the value fell to £3588, owing to the consumption of sugar produced from beetroot by the local sugar works. Of this total of £3588 there was furnished by:—

	£
United Kingdom	1166
United States	1603
Germany	449
Brazil, Netherlands, and Denmark	370

Porto Rico.

The crop of 1907 was abundant, both in cane and sucrose, on the north coast of the island, owing to the peculiarly favourable atmospheric conditions of the year. Even at the harvest time the weather was dry, which favoured grinding. This, however, was at the expense of the following crop, as the ratoons and the new plant canes at this time require rain and moisture in order to prosper.

The average yield of cane was about 25 tons to the acre with an extraction of about 10 lbs. of sugar to 100 lbs. of cane. The maximum extraction was 14 lbs. per cent. The average price of sugar was about 15s. per cwt.

On the south coast results were not so favourable, owing to drought. It is calculated that the crop was at least 25 per cent. short. Although there was some rain afterwards, it was not enough, so the 1908 crop will probably be small.

To remedy this serious difficulty, occurring so frequently, the subject of irrigation has been raised in the Legislative Assembly, and an amount voted to make an expert study of the case. The idea is to change the course of some of the rivers that rise on the central range of the island and now flow down its northern slope, and alternatively to build reservoirs to store the water during the wet season for timely distribution.

Sugar to the value of £3,141,933 was exported during the year, an increase in value over the record of 1906 of £158,350.

NEW BOOKS.

Die Dichten der Zuckerlösungen bei verschiedenen Temperaturen. *Dr. Sidersky.* Text in French and German. Vieweg & Sohn, Braunschweig, 1908. Price 2·75 m.

Die gebräuchlichsten Futtermittel des Handels. *P. Krische.* Asgard-Verlag, Leipzig, 1908. Price 0·6 m.

Handbuch der Technischen Mykologie für Technische Chemiker u.s.w. *F. Lafar.* Second revised and enlarged edition. Gustav Fischer, Jena, 1908. Price 4 m.

Distillerie Agricole et Industrielle Alcools, Eau-de-vie, et Rhums. *E. Boullanger.* Bailliere et Fils, Paris, 1908. Price 6 francs.

Die Raffination des Zuckers. *W. Gredinger.* H. Hartlebens Verlag, Vienna, 1908. Price 10 m.

Jahresbericht über die Untersuchungen u. Fortschritte auf dem Gebiete der Zuckerfabrikation. *Stammer and Bock.* Vieweg & Sohn, Braunschweig, 1908. Price 16 m.

Jahresbericht der Rübensamenzüchtungen. *Von Wohanka & Co.* Published by Authors at Vienna, 1908.

Water Softening and the Purification of Hard and Dirty Waters. *H. Collet.* Spon & Chamberlain, New York, 1908. Price 2 dollars.

ABSTRACTS, SCIENTIFIC AND TECHNICAL.*

Determination of Water in Masse-cuites, Syrups, and Molasses. *J. Mintz. Centr. Zuckerind., 1908, 16, 1102-1103.*

The method for the determination of water in masse-cuites, syrups, and molasses in which sand is used to aid dessication does not yield trustworthy results, and, moreover, requires considerable time. This has led the author to investigate the Wiley-Josse method of drying sugar products by means of bibulous paper.

Ordinary white filter-paper is cut into strips about 1-2 cm. wide by 3 metres long; these are rolled into spiral form and placed in a metallic capsule provided with a tightly-fitting cover, and dried at a temperature of 105-110° C. to constant weight. A quantity of 2-6

grms. of the sample under examination is dissolved in 6-8 c.c. of water, and this solution absorbed by the paper roll which is again heated at the same temperature until its weight is constant. The drying is preferably effected in a Schwackhöfer oven at a temperature of 105-110° C. and a diminished pressure of 50-65 c.cm.

After an application of this method to a variety of sugar products, the author concludes that it is both accurate and readily carried out; by it determinations can be made in 3-4 hours, whereas approximately constant weighings are generably obtainable by the sand method after 13-17 hours. With low refinery products which contain readily decomposable substances the results are less trustworthy, and when working with such it is recommended to take, as an indication of the water-content, the loss in weight obtained after heating for three hours in the manner described.

Estimation of Dry Substance by the Refractometer in Liquid Saccharine Food Products. *A. Hugh Bryan. Jl. Amer. Chem. Soc., 1908, 30, 1443-1451.*

The Abbe heatable prism refractometer has come into use in England for determining the dry substance content of sugar-house products. It is easy of manipulation, and the values for the dry substance obtained by it compare well with the figures for the actual dry substance. Hugh Main (this Jl., 1907, 481) and Prinsen Geerligs (this Jl., 1908, 68) have published tables from which the per cent. of water can be found from the refractive index, while the latter author also gives a table of temperature corrections to be applied. The salts and non-sugar substances are the main cause of difference, but even in a final molasses it was found by Geerligs that the dry substance by refractive index agrees very well with that obtained by dessication. As compared with the Brix reading (by pycnometer or spindle) the refractive index is in every case much nearer the actual dry substance. When the product being examined is dark in colour and an end-point in reading is difficult to obtain, or when the sample contains crystals of sugar, it should be diluted.

In the present paper the writer records a large number of determinations of the dry substance content of syrups and molasses by drying to constant weight on sand, and compares these results with those obtained by means of the refractometer and Geerligs' table of corrections.

It was found in most cases that the dry substance obtained by dessication is somewhat higher than by the refractometer, and that the refractometer values are much nearer the actual dry substance than those found by the hydrometer or by the sp. gr. from Brix tables. Purities obtained from the dry substance by the refractometer agree very closely with the "real" purity values. A table showing the

purities from dessication, sp. gr., and refractometer, for samples of cane and beet molasses is given.

The use of this instrument for the determination of dry substance is very highly recommended by the author by reason of the ease of manipulation, and the accuracy, with which a determination can be carried out.

NEW POLARIMETER. *M. Sidersky. Ann. Chim. Anal., 1908, 13, 14-15.*

In the new polarimeter of M. Pellin the field of vision shows concentric zones; in order to obtain this effect a circular disc is cut from the quartz plate which is found in the half-shadow type instrument in front of the prisms and is cemented to a transparent disc. By cutting from the quartz an annular disc and fitting this to a transparent disc, the effect of three concentric zones having a dark circle against a white back-ground, or *vice versa*, may be produced. The new polarimeter is a very sensitive one; the contrast disappears very sharply and distinctly at zero, so that readings are much more readily and accurately made with it than by means of the ordinary half-shadow instruments.

POLARIMETRIC READINGS WITH SMALL QUANTITIES OF LIQUID. *Julius Donau. Monatsh., 1908, 29, 333-336.*

The author has previously recommended the use of capillary tubes for use in colorimetric work; in the present article he describes their adaptation for polarimetric purposes when only small quantities of liquid are available. The tubes, 0·4—0·5 m.m. internal diam. and 5 or 10 cm. in length are made of black glass,* and are fixed by means of rubber stoppers inside the ordinary polarimeter tubes, the ends being closed by cover-glasses. With the 5 cm. tubes good results can be obtained by using an ordinary sodium flame lamp, but for the 10 cm. length the source of light recommended is that from a 6 ampère arc lamp, after filtering the light through red glass, or else that of an arc lamp, the carbons of which have been saturated with concentrated sodium chloride *in vacuo* and then dried.

The tubes are most conveniently filled by fixing them in an inclined position in a clamp, allowing the liquid to be examined to flow through them, and then closing both ends with small cover-glasses having a diam. of 3 m.m. The 5 cm. tube is most convenient for use, for it is more readily filled than the other, and can be used with an ordinary sodium flame lamp.

A table giving the results of observations of the rotation of different optically active liquids indicates that very satisfactory results can be obtained by these capillary tubes in comparison with the ordinary polarimeter tubes.

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* Procurable from Zeiss & Schott, of Jena (Capillary Black Glass, 1312, III.)

Detection and Identification of certain Reducing Sugars. *E. C. Kendall and H. C. Sherman. Jl. Amer. Chem. Soc., 1908, 30, 1451-1455.*

The reagent used is *p*-brombenzyl hydrazide. It is prepared by treating on the water bath a mixture of 10 grms. of ethyl *p*-brombenzoate, 8·2 grms. of a 50 per cent. aqueous solution of hydrazine, and 12 c.c. of 95 per cent. alcohol; the alcohol is distilled off after four hours, and the residue recrystallized from alcohol.

30 mgrms. of the sugar being tested, 60 mgrms. of the reagent, and 10-15 c.c. of alcohol are evaporated to dryness in a test-tube placed in a boiling water-bath. The residue, after evaporating with alcohol to dryness three or four times, is taken up with 5-6 c.c. of chloroform and 4-5 drops of water, and heating continued till the the liquid boils: the characteristic flakes of the hydrazone will then be found to remain suspended in the solution. When carried out in this way this test gives an insoluble hydrazone with dextrose, galactose, mannose, and arabinose; but not with levulose, maltose, or lactose. The non-reacting sugars interfere with the formation and separation of the hydrazones of those which do react.

The hydrazones of the reacting sugars differ markedly in their solubilities in alcohol whether heated directly in the dry state or while suspended in the chloroform-water mixture. These differences in solubility may suffice for the identification of the particular reacting sugar present. If the prescribed conditions and amounts of reagents have been adhered to, 20 c.c. of 95 per cent. alcohol should be added to the evaporated residue in the tube and boiled for 5 minutes: the hydrazone of dextrose dissolves, that of galactose is insoluble, whilst those condensed from mannose and arabinose are partly soluble.

This forms a useful qualitative test for the reacting sugars, and it compares favourably with those reactions already in common use.

Test for Pentoses with Orcinol and Hydrochloric Acid. *J. Pieraerts. Bull. Assoc. Chim. Sucr. et Dist., 1908, 26, 46-62.*

The coloration given by levulose and other keto group sugars with orcinol and hydrochloric acid masks that shown by pentoses. In order to overcome this difficulty, the author proposes that the levulose or other sugar present should first be expelled by fermenting with yeast.

Affination Power of Raw Sugars. *E. O. von Lippmann. Zeit. Ver. deut. Zuckerind., 1908, 692-707.*

The "affination" of raw sugars is the preliminary purification of the crystallized sugar from the surrounding syrup. It has as its purpose the separation, with as little loss of sucrose as possible, of the non-sugar impurities from the crystals, and the consequent lessening of the work of refining.

The endeavour of the refiner should be to produce a sugar of the greatest affination power. In the author's paper the means by which this is decreased were discussed; the chief factors causing an increase of affination are:—

(1) The use of an insufficient amount of lime in defecation.

(2) Too rapid working of the raw material through the factory.

(3) Careless boiling and centrifugalling.

(4) An insufficient cleansing of the pans, causing burnt particles and dirt to pass into the masse-cuite.

SPECIFIC GRAVITY OF SUGAR CRYSTALS. *G. Fouquet. Bull. Assoc. Chim. Sucr. et Dist., 1908, 26, 176-177.*

The sp. gr. of sucrose crystals can be varied by modifying the method of crystallization. The differences were found to be in one case 1550-1575, and in another 1580-1610. Filhol, Buignet, and others have found that the sp. gr. of a substance increases with the regularity of the form of its crystals, and the author is investigating the application of this statement to his observation.

Other subjects are:—

PERRIN'S MECHANICAL FILTRATION METHOD. *F. Lêgier. Sucr. Indigène, 1908, 72, 525-330.*

KARLIK-CZAPIKOWSKI PROCESS. *Puvrez de Groulart. Sucr. Indigène, 1908, 72, 530.*

BEET SUGAR MANUFACTURE IN CALIFORNIA. *D. Zuckerind., 1908, 33, 870.*

CRYSTAL DETERMINATION IN RAW SUGARS. *H. Frerst. Centr. Zuckerind., 1908, 16, 150.*

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. THOMPSON, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; 77, Market Street, Bradford; and 322, High Holborn, London.

ENGLISH.—APPLICATION.

23313. W. MACKIE, Glasgow. *Improvements in connection with dumb-turners for sugar cane mills.* 2nd November, 1908.

ABRIDGMENT.

26109/07. R. HARVEY, Glasgow. *Improvements in and relating to apparatus for heating sugar juice and other liquids.* 26th November, 1907. This invention has reference to improvements in and relating to apparatus for heating sugar juice and other liquids, by forming at the top of one end of the heater pocket chambers for the inlet and outlet of the juices which circulate through tubes in the compartments of the heater.

200970. EMIL SOMMERSCHUH, of Rakonitz, Bohemia, and PETER SPENGLER, of Merzig, Saar, Rhenish Prussia. *A centrifugal machine having worms rotating in the drum and surrounded by walls, for expelling the dried centrifugalled material.* 25th November, 1906. This centrifugal machine is provided with worms enclosed with walls and rotating in the drum, for expelling the dried material, the diameter of the worms and the respective chambers tapering towards the outlets, and the speed of rotation of the worms being capable of being altered. The casing round the drum serving for catching the expelled material and which is located opposite the apertures in the drum, is revoluble and is freed from adherent material by means of a fixed knife.

201410. MASCHINENFABRIK GREVENBROICH, of Grevenbroich, Rhine province. *A stone catching device in apparatus for washing beetroot and other bulbs, having a device for the introduction of compressed air for the purpose of preventing the material washed escaping with the stones.* 4th January, 1908. In this apparatus the device closing the stone catcher is itself made hollow and also provided with holes and connected by means of a hollow shaft with an air valve, in such a way that a compulsory introduction of the air into the stone catcher takes place on the device, which closes the bottom of the stone catcher descending.

201411. MASCHINENFABRIK GREVENBROICH, of Grevenbroich, Rhenish Prussia. *Apparatus for making dry loose sugar from plain boiled masse-cuite.* 8th September, 1907. This apparatus has a stirring and kneading mechanism, the arms of which are moved in the same direction, and are curved in the ordinary way spirally, whereby the mass is thoroughly mixed, pushed against the walls of the vessel and crushed against them. The spiral kneading arms are arranged one above the other and displaced relatively to one another, which is another feature of the invention.

201412. THE FIRM OF N. HELLMAN, of Vienna. (Patent of addition to Patent No. 159413, of 26th April, 1904.) *Loaf sugar press.* 11th September, 1907. This is a modification of the loaf sugar press covered in the main patent No. 159413, and consists in the pressing mould being divided longitudinally, and one or both halves of the pressing mould serving as the press stamp, whilst the open side of the mould, which forms the base of the sugar loaf, is adapted to be closed by a slide.

201990. IVAR PETER BAGGER KNUDSEN, of Copenhagen. *A centrifugal machine having a drum oscillatingly supported on the driving shaft.* 21st August, 1906. In this apparatus the drum is mounted above the driving shaft by means of a guide bush on a sheath or socket, which surrounds the shaft in such a way that the drum is

revoluble and displaceable, and adapted to oscillate in the ordinary way, which sheath or socket in turn is provided with a brake device for receiving the jolts of the drum.

201825. MORIZ WEINRICH, of Yonkers, New York. *A process for neutralizing the juice in beetroot pulp treated (separated) with lime.* 12th April, 1907. This process consists in the limed beetroot pulp, heated to from 60° to 65° C., being neutralized to a suitable extent with phosphoric acid, then again heated to from 70° to 75° C., and finally expressed in the ordinary way.

NOTE.—Copies of all published specifications with their drawings in these lists can be obtained from W. P. Thompson & Co., 6, Lord Street, Liverpool, at One Shilling a copy for English or American Patents, and Two Shillings for German. In ordering please give number and date.

STOCKS OF SUGAR IN EUROPE AT UNEVEN DATES, NOV. 1ST TO 21ST, COMPARED WITH PREVIOUS YEARS.

IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	TOTAL 1908.
132	688	345	445	86	1696

	1907.	1906.	1905.	1904.
Totals	1592 ..	1665 ..	1697 ..	1557

TWELVE MONTHS' CONSUMPTION OF SUGAR IN EUROPE FOR THREE YEARS, ENDING OCTOBER 31ST, IN THOUSANDS OF TONS.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria-Hungary	Holland, Belgium, &c.	Total 1907-08.	Total 1906-07.	Total 1905-06.
1857	1214	666	566	214	4518	4380	4491

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of October, 1907 and 1908.

IMPORTS.

Raw Sugars.	Quantities. 1907. Cwts.	Quantities. 1908. Cwts.	Values. 1907. £	Values. 1908. £
Germany	6,392,775	6,070,852	3,067,198	3,225,906
Holland	456,854	363,369	232,762	189,148
Belgium	336,152	384,436	155,266	200,143
France	419,948	299,636	217,505	177,474
Austria-Hungary	309,575	454,202	140,343	243,147
Java	901,668	1,192,270	475,754	607,727
Philippine Islands	187,693	214,588	77,287	88,962
Cuba	91,113	....	39,600	....
Peru	464,243	854,580	228,720	461,002
Brazil	189,899	14,724	78,405	7,844
Argentine Republic	....	....	....	....
Mauritius	498,576	389,442	204,132	172,185
British East Indies	116,135	158,828	50,517	70,889
Straits Settlements	185,550	110,789	76,188	48,984
Br. W. Indies, Guiana, &c.	1,126,587	758,860	649,253	525,663
Other Countries	520,426	520,922	256,404	289,327
Total Raw Sugars	12,197,194	11,787,498	5,949,334	6,308,401
Refined Sugars.				
Germany	10,758,722	11,771,420	6,376,067	7,547,198
Holland	2,102,514	2,017,758	1,340,738	1,383,874
Belgium	365,937	229,497	223,877	148,321
France	3,001,024	1,449,571	1,763,011	965,502
Other Countries	2,685	335,502	1,858	207,017
Total Refined Sugars	16,230,882	15,803,748	9,705,551	10,251,912
Molasses	2,324,751	2,305,769	462,226	473,598
Total Imports	30,752,827	29,897,015	16,117,111	17,033,911

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	292	673	220	280
Norway	11,820	8,610	7,261	5,695
Denmark	79,861	77,568	43,824	47,459
Holland	57,436	58,764	38,900	41,948
Belgium	7,960	7,020	4,922	4,855
Portugal, Azores, &c.	15,212	20,883	8,608	12,818
Italy	22,469	6,560	12,341	3,995
Other Countries	409,826	266,525	304,691	208,471
	604,876	446,603	420,767	325,521
Foreign & Colonial Sugars				
Refined and Candy	30,845	13,128	20,731	10,383
Unrefined	64,218	349,092	38,262	219,167
Molasses	4,146	2,778	1,252	1,100
Total Exports	704,085	811,601	481,012	556,171

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1908. Tons.		1907. Tons.
Total Receipts Jan. 1st to Nov. 19th ..	1,865,397	..	1,813,316
Receipts of Refined ,, ,, ...	1,152	..	730
Deliveries ,, ,, ...	1,853,918	..	1,811,888
Importers' Stocks, November 14th....	17,099	..	1,428
Total Stocks, November 25th	184,000	..	154,780
Stocks in Cuba, ,, ...	3,000	..	30,000
	1907.		1906.
Total Consumption for twelve months..	2,993,979	..	2,864,013

CUBA.

Statement of Exports and Stocks of Sugar, 1907 and 1908.

(Tons of 2,240lbs.)	1907. Tons.		1908. Tons.
Exports	1,316,309	..	876,094
Stocks	63,045	..	34,534
	1,379,354	..	910,628
Local Consumption (9 months)	34,980	..	44,040
	1,414,334	..	954,668
Stock on 1st January (old crop)	....	..	9,318
Receipts at Ports up to September 30th ..	1,414,334	..	945,350

Havana, September 30th, 1908. J. Guma.—F. Mejer.

UNITED KINGDOM.

Statement of Imports, Exports, and Consumption for Ten Months, ending October 31st, 1908.

Sugar.	Imports. 1906. Tons.		Imports. 1907. Tons.		Imports. 1908. Tons.	Exports (Foreign). 1906. Tons.		Exports (Foreign). 1907. Tons.		Exports (Foreign). 1908. Tons.
Refined	740,918	..	811,544	..	790,187	1,543	..	1,542	..	656
Raw	638,050	..	609,859	..	589,375	7,836	..	3,211	..	17,454
Molasses	119,133	..	116,237	..	115,288	277	..	207	..	139
Total..........	1,498,101	..	1,537,640	..	1,494,850	9,656	..	4,960	..	18,249

	Home Consumption. 1906. Tons.		1907. Tons.		1908. Tons.
Refined..	721,802	..	800,480	..	767,029
Refined (in Bond) in the United Kingdom	457,036	..	421,120	..	448,364
Raw	99,743	..	100,773	..	97,249
Molasses	108,126	..	107,274	..	112,775
Molasses, manufactured (in Bond) in U.K.	49,658	..	51,592	..	53,361
Total..................................	1,436,365	..	1,481,239	..	1,478,778
Less Exports of British Refined.....................	40,307	..	30,243	..	22,330
Total Home Consumption of Sugar	1,396,058	..	1,450,996	..	1,456,448

ESTIMATED CROP OF CANE SUGAR IN THE DIFFERENT COUNTRIES FOR THE CURRENT CAMPAIGN COMPARED WITH THE ACTUAL CROP OF THE THREE PREVIOUS CAMPAIGNS.

(Licht's Circular.)

	1908-09. Tons.	1907-08. Tons.	1906-07. Tons.	1905-06. Tons.
Cuba	1,200,000	908,733	1,387,853	1,288,850
Porto Rico	200,000	147,356	212,359	205,272
Trinidad	40,000	37,118	41,280	51,272
Barbados	30,000	30,092	38,100	52,861
Martinique	40,000	38,939	40,443	40,971
Guadeloupe	35,000	35,969	35,348	34,872
British Guiana..	110,000	95,606	118,121	123,002
Brazil	210,000	130,000	175,000	210,000
Java	1,050,000	1,222,961	922,904	838,307
Philippine Islands	130,000	129,129	110,688	124,211
Mauritius	190,000	165,322	208,133	188,745
Réunion..	35,000	34,065	42,925	26,410
Jamaica	15,000	15,000	18,000	17,000
Lesser Antilles	100,000	80,000	97,000	95,000
United States	800,000	785,000	676,010	624,411
Peru	160,000	140,000	140,000	128,672
Egypt..	40,000	40,000	50,000	50,000
Hawaiian Islands	500,000	470,000	440,017	429,213
	4,885,000	4,505,290	4,754,181	4,529,069

ESTIMATED CROP OF BEETROOT SUGAR ON THE CONTINENT OF EUROPE FOR THE CURRENT CAMPAIGN, COMPARED WITH THE ACTUAL CROP OF THE THREE PREVIOUS CAMPAIGNS.

(From Licht's Monthly Circular.)

	1908-1909. Tons.	1907-1908. Tons.	1906-1907. Tons.	1905-1906. Tons.
Germany	2,100,000	2,127,000	2,239,179	2,418,156
Austria	1,375,000	1,425,000	1,343,940	1,509,789
France	800,000	728,000	756,094	1,089,684
Russia	1,300,000	1,410,000	1,440,130	968,500
Belgium	250,000	232,000	282,804	328,770
Holland	195,000	175,000	181,417	207,189
Other Countries .	470,000	435,000	467,244	410,255
	6,490,000	6,532,000	6,710,808	6,932,343

Date of issue.	Date of issue.	Date of issue.